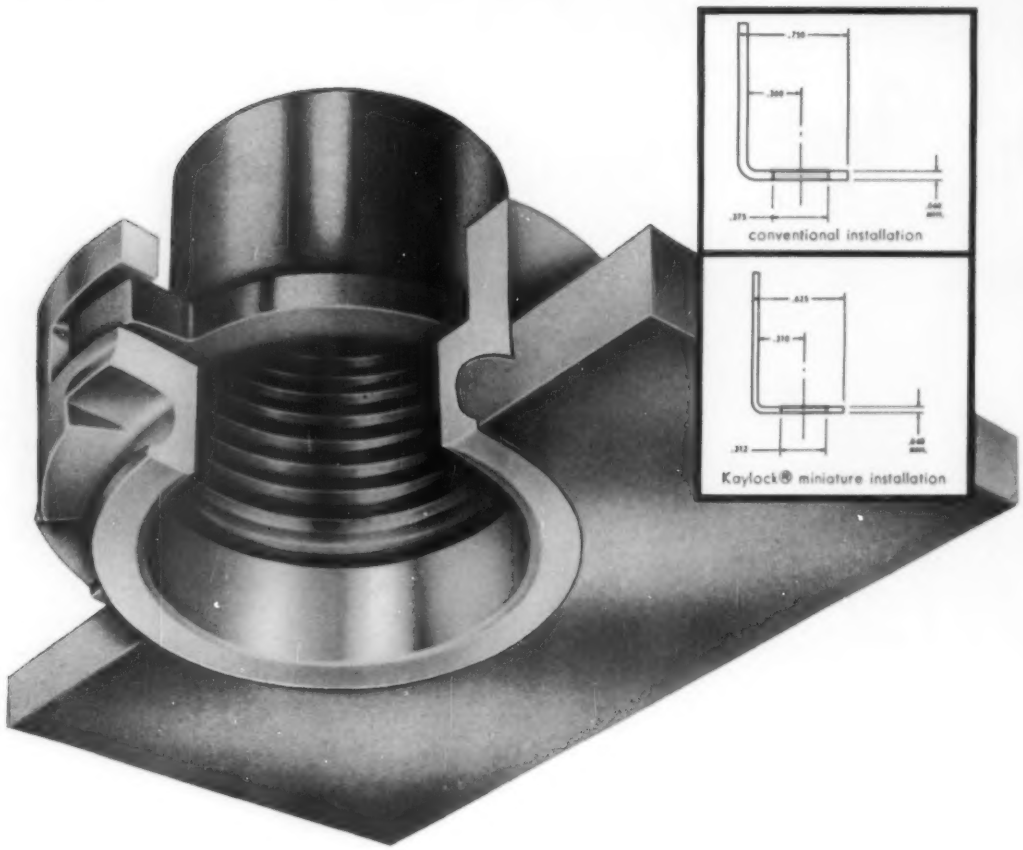
Aviation Week and Space Technology

A McGraw-Hill Publication

December 5, 1960

Special Report On German Industry

Bell D-188A V/STOL Mockup

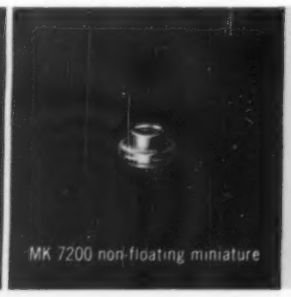


No mistaking Kaynar's new stake nut—it's miniaturized

The new Kaylock® Miniature Stake Nuts bear the unmistakable mark of Kaynar's leadership in aerospace fastener weight and space savings. These new miniatures answer the critical need for installed reliability of threaded elements in minimum thickness materials...can save you up to 33% of hardware weight. Additional savings can accrue as a result of thinner parent material requirements (.030 minimum thickness for Kaylock Non-Floating Stake Nuts, .040 minimum for Floating Stake Nuts.)

Easier and Quicker to Install. No flaring of the nut shank is required. The pressure used in installation results in a cold flow of the parent material. This interlock of the nut and the mating material, in a smaller installation hole, provides greater structural integrity. Staking action of the Kaylock self-locking nut provides maximum retention against push-out and torque-out. The new series is available in miniature and regular configurations, both floating and non-floating. *Write today* for the new *Kaylock Stake Nut Brochure,* or contact your Kaynar representative.

MF 7200 floating miniature


MK 7200 non-floating miniature

Kaylock®
first in lightweight locknuts

KAYNAR MFG. CO., INC., KAYLOCK DIVISION
Box 2001, Terminal Annex, Los Angeles 54, Calif. Branch offices, warehouses & representatives in Wichita, Kan.; New York, N.Y.; Atlanta, Ga.; Renton, Wash.; Montreal; Paris; London; The Hague

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2. **Polaris Suspension System** "floats" missile inside container on rubber-and-nylon air cushions.

3. **Communication Systems**—portable, light weight, proved; offer wide variety of communications gear.

Standardizing G.S.E.? It's Standard Operating Procedure at GAC. Design philosophy which insists on reducing the number of units to meet the support requirements for each new system is Standard Operating Procedure at Goodyear Aircraft. Shown here are examples of GAC-built ground support equipment which benefits from this standardization approach. Diverse as the requirements are, each unit has been developed to perform the functions of many units. If you are interested in reducing the problems of logistics on your GSE requirements, let us find the common denominator. Write Goodyear Aircraft Corporation, Dept. 916AX, Akron 15, Ohio, or Litchfield Park, Arizona.

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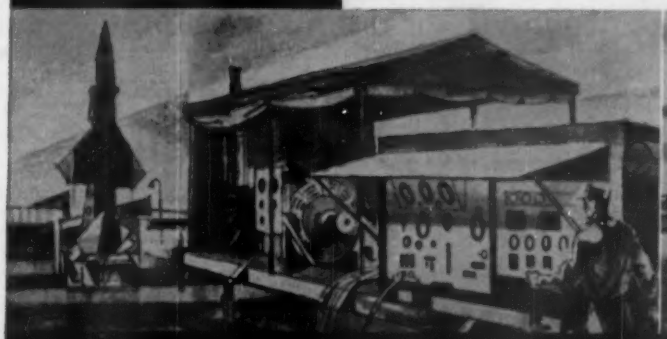

4. **Transportable Power Pack** supplies all launch-site power needs—5 different power sources plus engine-start fuel system.

5. **Mobile Airship Handling Winch**—Drastically reduces man power required for ground handling.

Five European NATO nations will produce the U. S. Army Hawk missile as the primary ground-to-air defense weapon in Western Europe. Raytheon, developer and prime contractor in the U.S. for the Hawk, is supplying technical assistance to manufacturers selected by these NATO countries.

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EXCELLENCE IN ELECTRONICS

AVIATION CALENDAR

Dec. 12-15—Atomic Industry Exhibition, California Masonic Memorial Temple, San Francisco, Calif.

Dec. 13-15—Tenth Annual Eastern Joint Computer Conference, Hotel New Yorker and Manhattan Center, New York, N. Y.

Dec. 16—Army Aviation Contract Services Symposium, National Aeronautical Services Assn., Mayflower Hotel, Washington, D. C.

Dec. 16—Fifth Convertible Aircraft Congress, Convertible Aircraft Pioneers, Cosmos Club, Washington, D. C.

Dec. 17—24th Wright Brothers Lecture, Natural History Bldg., Smithsonian Institution, Washington, D. C.

Dec. 26-31—127th Meeting, American Association for the Advancement of Science, New York, N. Y.

Dec. 28-30—Seventh King Orange International Model Plane Meet, Miami, Fla.

Jan. 9-11—Seventh National Symposium on Reliability and Quality Control, Bellevue-Stratford Hotel, Philadelphia, Pa.

Jan. 9-13—International Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit, Mich.

Jan. 15-18—13th Annual Convention, Helicopter Assn. of America, Cherry Hill Inn, Haddonfield, N. J.

Jan. 16-18—Seventh Annual National Meeting, American Astronautical Society, Dallas, Tex.

Jan. 17-19—Winter Instrument-Automation Conference & Exhibit, Instrument Society of America, Jefferson Hotel and Kiel Auditorium, St. Louis, Mo.

Jan. 23-25—29th Annual Meeting, Institute of the Aeronautical Sciences, Hotel Astor,

(*Continued on page 6*)

AVIATION WEEK and Space Technology

December 5, 1960

Vol. 73, No. 23

Published weekly with an additional issue in December by McGraw-Hill Publishing Company. James H. McGraw (1860-1948), Founder. See panel below for directions regarding subscription or change of address. **Executive, Editorial, Circulation and Advertising Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Printed at Albany, N. Y. **OFFICERS OF THE PUBLICATIONS DIVISION: Nelson L. Bond, President; Shelton Fisher, Wallace F. Traendly, Senior Vice Presidents; John R. Callaham, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator. OFFICERS OF THE CORPORATION: Donald C. McGraw, President; Joseph A. Gerardi, Hugh J. Kelly, Harry L. Waddell, Executive Vice Presidents; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary.**

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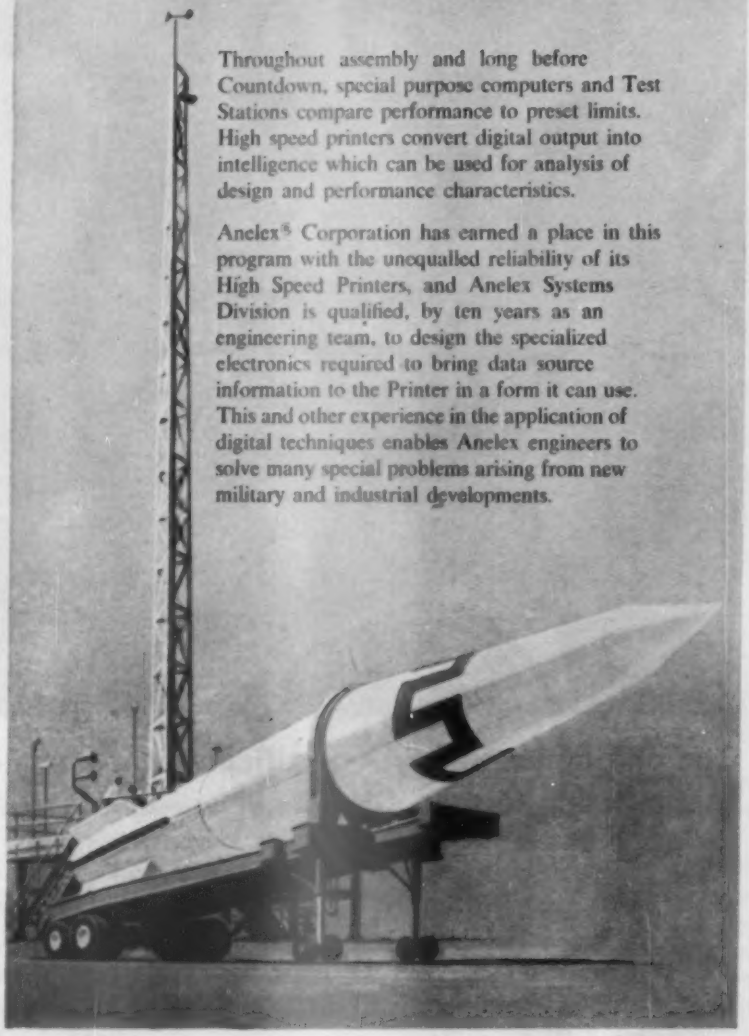
Long Before Countdown...



Throughout assembly and long before Countdown, special purpose computers and Test Stations compare performance to preset limits. High speed printers convert digital output into intelligence which can be used for analysis of design and performance characteristics.

Anelex® Corporation has earned a place in this program with the unequalled reliability of its High Speed Printers, and Anelex Systems Division is qualified, by ten years as an engineering team, to design the specialized electronics required to bring data source information to the Printer in a form it can use. This and other experience in the application of digital techniques enables Anelex engineers to solve many special problems arising from new military and industrial developments.

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World's most experienced makers of utility military aircraft

AVIATION CALENDAR

(Continued from page 5)

New York, N. Y. Honors Night Dinner, Jan. 24.

Feb. 1-3—Second Winter Military Electronics Convention, Institute of Radio Engineers, Biltmore Hotel, Los Angeles.

Feb. 1-3—Solid Propellants Conference, American Rocket Society, Salt Lake City.

Feb. 15-17—International Solid-State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel, Philadelphia.

Mar. 5-9—Sixth Annual Gas Turbine Conference and Exhibit, American Society of Mechanical Engineers, Shoreham Hotel, Washington, D. C.

Mar. 9-10—Second Symposium on Engineering Aspects of Magnetohydrodynamics, University of Pennsylvania, Philadelphia.

Mar. 9-10—Flight Propulsion Meeting, Institute of the Aeronautical Sciences, Cleveland, Ohio (classified).

Mar. 12-16—Aviation Conference, American Society of Mechanical Engineers, Statler-Hilton, Los Angeles, Calif.

Mar. 13-15—Flight Testing Conference, American Rocket Society, Los Angeles.

Mar. 13-16—Test, Operations and Support Conference, American Rocket Society, Biltmore Hotel, Los Angeles, Calif.

Mar. 16-18—Fifth National Conference on Aviation Education, Mayflower Hotel, Washington, D. C.

Mar. 20-23—International Convention, Institute of Radio Engineers, Coliseum and Waldorf Astoria Hotel, New York, N. Y.

Mar. 20-24—1961 Western Metal Exposition, American Society for Metals, Pan-Pacific Auditorium, Los Angeles, Calif.

Apr. 4-6—International Symposium on Electromagnetics and Fluid Dynamics of Gaseous Plasma, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Apr. 5-7—Lifting Re-entry Vehicles: Structures, Materials & Design, American Rocket Society, Palm Springs, Calif.

Apr. 17-28—14th Technical Conference, International Air Transport Assn., Queen Elizabeth Hotel, Montreal, Canada.

Apr. 18-20—Symposium on Chemical Reactions in the Lower and Upper Atmosphere, Stanford Research Institute, Mark Hopkins Hotel, San Francisco, Calif.

Apr. 20-22—General Meeting, American Meteorological Society with the American Geophysical Union, Washington, D. C.

Apr. 26-28—Liquid Rockets, Propellants and Combustion Conference, American Rocket Society, Palm Beach Biltmore, Palm Beach, Fla.

Apr. 30-May 4—Seventh National Aero-Space Instrumentation Symposium, Instrument Society of America, Adolphus Hotel, Houston, Tex.

May 8-10—National Aeronautical Electronics Conference, Institute of Radio Engineers, Miami and Biltmore Hotels, Dayton, Ohio.

May 9-11—Western Joint Computer Conference and Exhibit, Ambassador Hotel, Los Angeles, Calif.

May 22-24—National Telemetering Conference, Sheraton-Towers Hotel, Chicago, Ill.

May 26-June 4—24th French International Air Show, Le Bourget, Paris, France.

Sept. 4-10—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Raytheon Fire Control Radar System installed in newest missile destroyer

Raytheon AN/SPG-51 fire control radars are operational aboard the U.S.S. CHARLES F. ADAMS (DDG-2). As the Mark 74 Fire Control Systems Coordinator for the Bureau of Naval Weapons, Raytheon is carrying out serial production of the advanced design AN/SPG-51.

The ADAMS, first destroyer built from the keel up to launch guided missiles, carries out its Anti-Air Warfare mission with TARTAR surface-to-air missiles. The radar tracks intruders and guides the missile even to low altitude targets despite the use of evasive tactics or electronic countermeasures.

Each AN/SPG-51 consists of a single dish tracking and guidance radar. The radar tracks at long ranges with exceptionally low power.

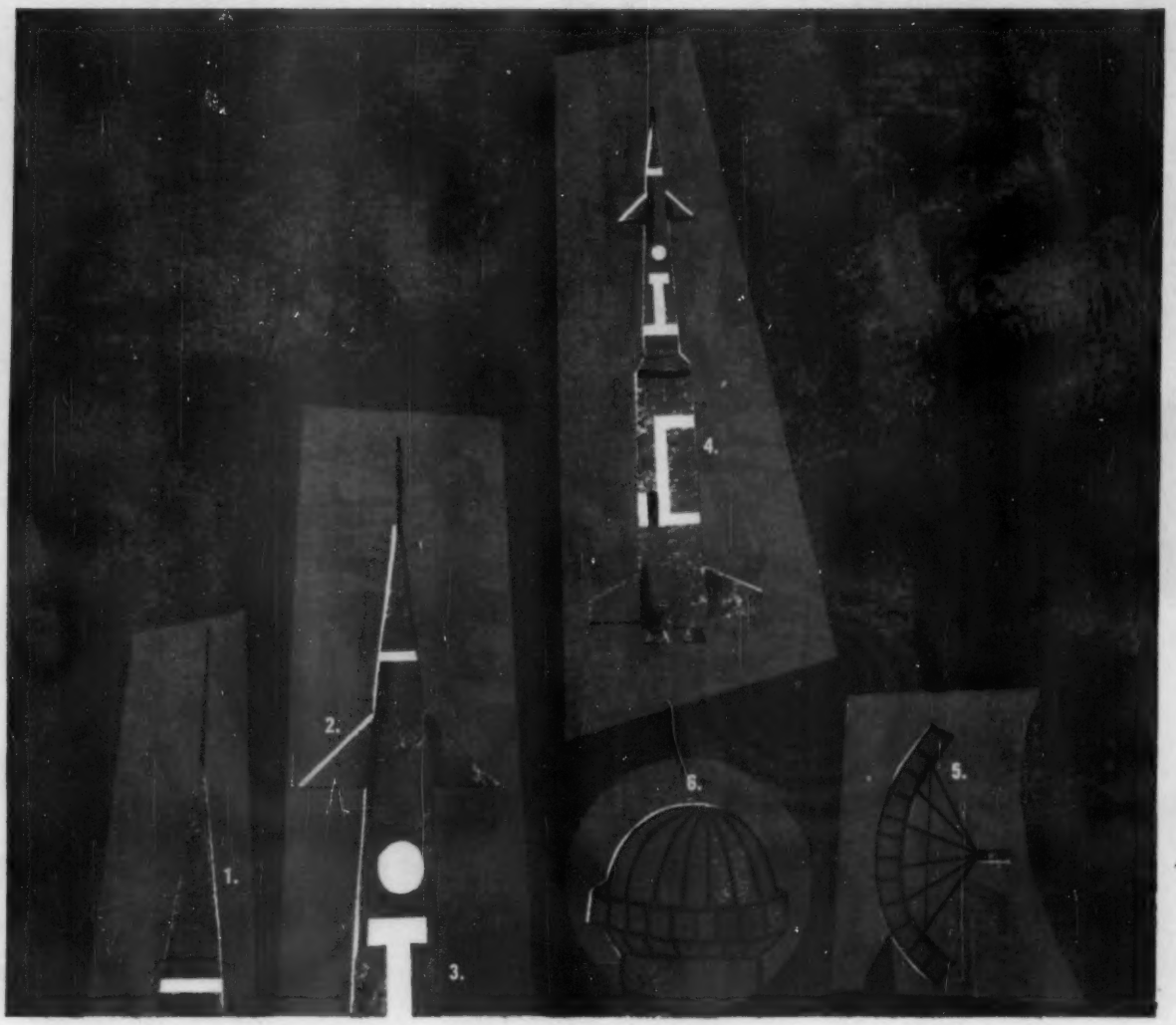
Upon assignment, AN/SPG-51 automatically acquires and tracks the target. Seconds before missile launch, the target is illuminated with a guidance beam. The missile homes on the reflected signal.

The AN/SPG-51 features excellent sub-clutter visibility and exceptional techniques to resist jamming. Selected by the Bureau of Naval Weapons for guided missile applications, this is the first fire control radar of its type to be procured in quantity.

RAYTHEON

RAYTHEON COMPANY

EQUIPMENT DIVISION



BRUNSWICK OFFERS COMPLETE CAPABILITY FOR AEROSPACE PROJECTS

"Complete capability" sums up Brunswick's ability to produce results at any stage of missile development. From in-house design and production to thorough testing, Brunswick brings to each new job a vast background in successful development of components and primary structures. **1. In nose cones and radomes,** Brunswick designs and materials can be tailored to meet rigorous new requirements for high temperature electrical and ablative purposes. **2. In wings and fins,** Brunswick engineering allows new plastic structures and antennas utilized in combination for more design freedom with maximum efficiency. **3. Missile bodies** constructed by the Strickland "B" fiber glass filament-winding process offer exceptional values in weight-strength ratios while meeting design requirements for unusual shapes and sizes. **4. Brunswick rocket motor cases** constructed by the Strickland "B" fiber glass filament-winding process consistently demonstrate superior properties, whether large or small. *Pressure vessels* designed by Brunswick can deliver an S/D ratio as high as 2,000,000. **5. Reflectors** of metal honeycomb or plastic construction are designed and manufactured to meet close tolerance and conform to the highest standards of quality and performance. **6. Ground radomes** are readily available for ground support applications. Constructed of solid laminate, honeycomb core, or foam, they are standard production design at Brunswick. From the starting line, or at any stage of the development race, Brunswick's complete capability is ready to make your ideas work faster and better. Call on Brunswick's ability to produce results. Brunswick Corporation, Defense Products Division, 1700 Messler Street, Muskegon, Michigan.

MAKES YOUR IDEAS *WORK*

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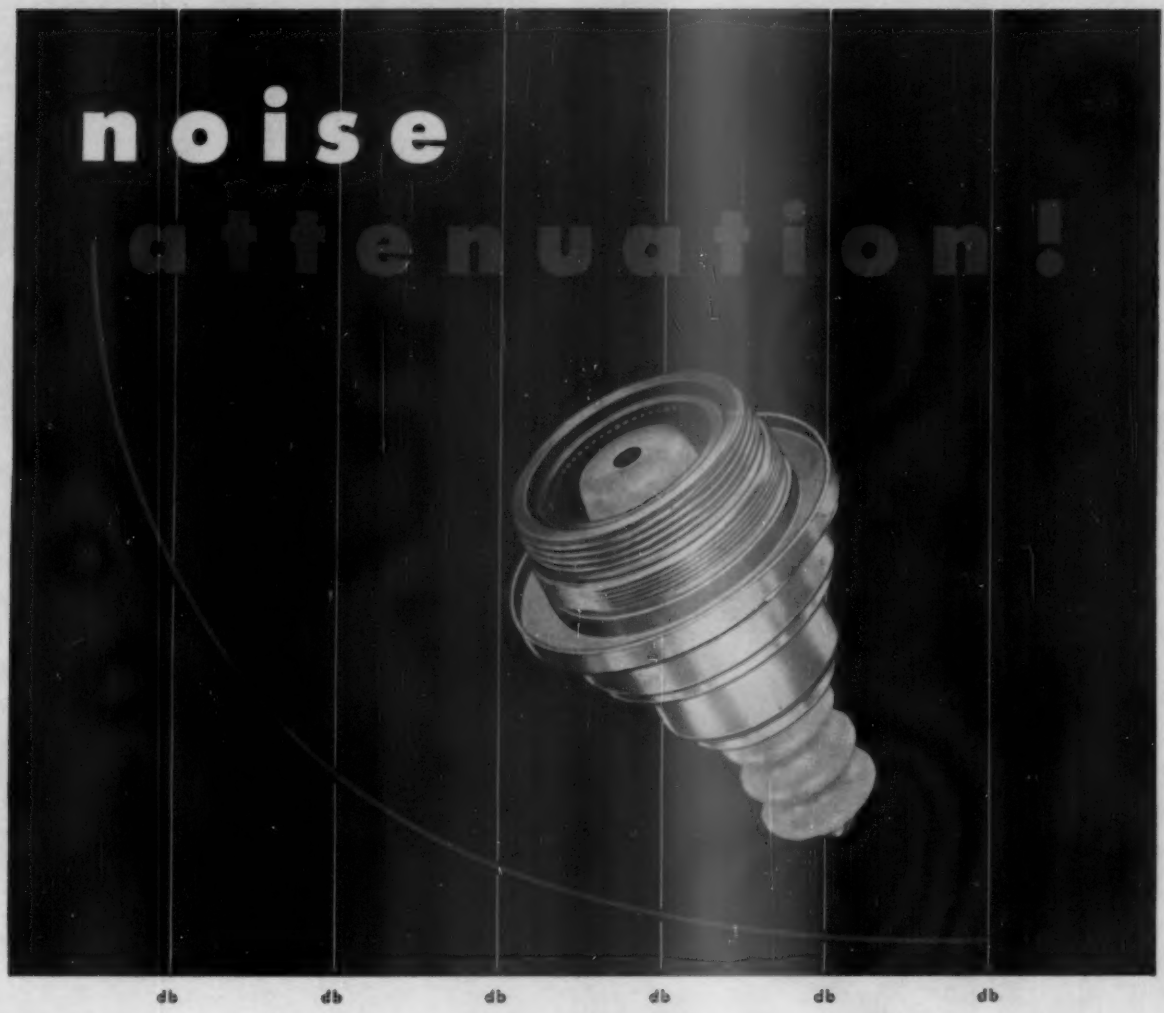

Double-shielded TRIAXIAL connectors
for hi-current, pulsed circuit cable assemblies

features . . . corona ratings through 45 kv d-c, or 35 kv pulsed d-c. Performance-tested at —55°C under conditions of humidity, shock, vibration and salt spray without functional impairment. Bulkhead pressure-tested to withstand 75 psi.

available . . . Air-to-Air and Air-to-Oil RECEPTACLES • Right Angle RECEPTACLES • Double end ADAPTERS • Field-assembled and Molded-to-Cable PLUGS • Waterproof RECEPTACLE CAP.

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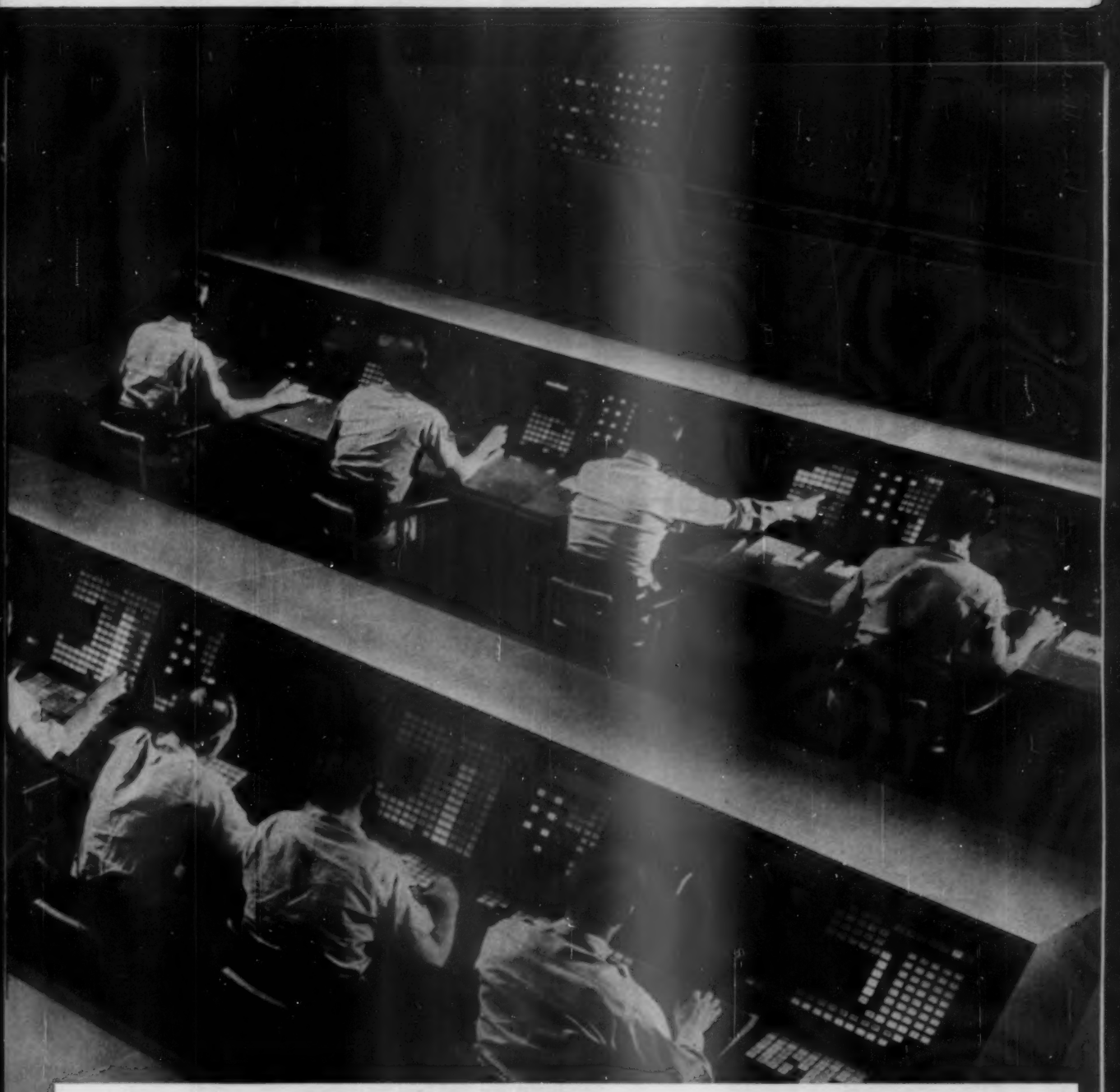
AN ACHIEVEMENT IN DEFENSE ELECTRONICS



412L Strengthens Air Defense By Integrating Airspace Management

Rapid coordination of all phases of military airspace management is a major problem of air defense. This simulated operations room depicts the heart of the Air Force's 412L Air Weapons Control System—a single, semi-automatic electronic complex which coordinates radar stations, data processing and display centers and weapons bases into a unified network.

Within seconds, 412L will provide the vital detection and tracking data to human decision makers. Precious time will be gained since computations leading up to the final decisions will be done automatically. In addition, 412L is a highly flexible system designed for use throughout the Free World. It will operate in mobile as well as fixed environments.

Currently going into prototype production, 412L has already anticipated technological advances. And, importantly, new equipment can be integrated into this versatile Air Weapons Control System in the future, assuring a complex which will remain combat-ready for many years.

176-05

Progress Is Our Most Important Product

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DEFENSE ELECTRONICS DIVISION • SYRACUSE, NEW YORK

GENERAL ELECTRIC

BETTER, CLEANER, MORE WORKABLE STEELS

through A-L Vacuum Melting Techniques

Microstructure of Ti-hardened A-286 showing Ti compound stringers in Air Melt (above) and absence of such stringers in Vacuum Melt (below).

What you can expect from A-L's Consutrode,® Invac, and Invacutrode steels and alloys.

If you have really critical applications, you need A-L's Consutrode, Invac, and Invacutrode steels and alloys, products of unique vacuum melting operations. These alloys provide a combination of improved metallurgical and mechanical properties. They give you the ultimate in complex high-temperature missile and aircraft superalloys . . . provide the finest bearing steels, low alloy steels, stainless steels, tool steels . . . meet the most critical applications . . . withstand the worst service conditions.

Here are a few of the specific advantages you get in A-L's vacuum melted materials:

- √ Higher mechanical properties—fatigue strength, transverse ductility, toughness
- √ Improved cleanliness and decreased gas content
- √ Better hot and cold workability
- √ Higher Reliability—Extended Life
- √ Fewer Rejections—Decreased Part Cost

A-L's modern melting techniques can be applied to help solve your problems. And these vacuum melted steels are in regular production, available now in all commercial mill forms and sizes.

For further information on A-L's modern melting techniques and the advantages of Consutrode, Invac, and Invacutrode alloys, get the new booklet, "Modern Melting at Allegheny Ludlum." It's packed with engineering data. Ask your nearest A-L sales office for a copy, or write: ***Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania. Address Dept. AW-12.***

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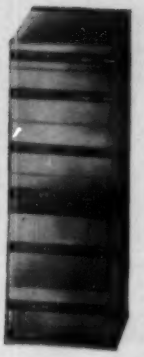

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Compatible with existing FM FM systems. Digital modulation of subcarrier provides increased accuracy and rapid data reduction capabilities. Up to 10 bits transmitted on a 70 KC subcarrier. Subcarriers and Discriminators to 300 KC available for increased frequency response. VECTOR Manufacturing Company Inc., Southampton, Pennsylvania.

TELEMETRY COMPONENTS AND SYSTEMS

Fly it...Float it...Pull it... CONDEC

Unitized, air-conditioned mobile shelters

Typical of Condec mobile shelters are these air-conditioned vans which can be joined in building-block fashion to provide any desired floor area. Transportable by land, sea and air, they provide comfortable working conditions from the Arctic to the tropics.

Fitted out as the electronic workshops shown here, they weigh less than 3,500 pounds. Equipment installed includes workbenches, instrument cabinets, outlets for 120/208-volt, 400-cycle AC and 28-volt DC, fluorescent lighting, emergency battery lighting, air-conditioning and heating.

The detachable, elevating undercarriage designed by Aircraft Equipment Division engineers adds a new connotation to the word "mobile." For loading in cargo planes, one crank elevates the body to platform height; four quarter-turn fasteners separate body from running gear, ready to be skidded aboard. When tow bar is released, brakes are automatically applied. Want to know how Condec can help you with your mobile shelter requirements? Call or write Mr. Jerome I. Davis, Vice President, Aircraft Equipment Division.

Condec Products for Missiles and Aircraft

Special-purpose vehicles, like this runway sweeper, are key products at Consolidated Diesel. Other vehicles supply all power requirements for ground support of missiles and aircraft.

Test equipment covers entire range of systems to check hydraulic, pneumatic, electrical and mechanical operating parameters.

Special airborne devices include products like this radiosonde dispenser design that cuts weight 40%, space 16%, improved and simplified operating system.

AIRCRAFT EQUIPMENT DIVISION

CONSOLIDATED DIESEL ELECTRIC CORPORATION

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An entirely new order of graphic information is now available to intelligence specialists for space-time-terrain surveillance. The superior visual sensing quality of photography, enhanced further by Houston Fearless Corporation's electronic *Ultrahancer*, presents significant strategic and tactical information beyond the scope of present instruments. This new graphic intelligence is resolved by a six-phase system of exposure control, contrast intensification by shaped area filtering, linearization of the photographic process, selective amplification, line drawing presentation by electronics, and automated brightness and contrast control during projection. The Ultrahancer is but one of the exciting components of the Westwood Division's IAI system of *information acquisition and interpretation* for military and scientific purposes. Inquiries will be given immediate attention. Scientists and engineers wishing to join in this advanced work will receive every consideration. Westwood Division, HF Houston Fearless Corporation, Los Angeles 64, Calif.

A. First Stage.

The first stage servo system controls the vehicle in response to signals from the guidance system in the third stage. This control is accomplished by means of jet vanes located behind the nozzle and by aerodynamic surfaces which become effective toward the end of first stage operation. A variable displacement hydraulic pump in the first stage supplies the control servos for the jet vanes and aerodynamic surfaces which are mounted on a common shaft. A first stage battery supply provides power for this hydraulic pump assembly. A programmer in the third stage controls first stage separation, coast time, and second stage ignition. Honeywell pfovides the above servo system, third stage guidance system, hydraulic pump assembly, battery supply and third stage programmer.

B. Second Stage.

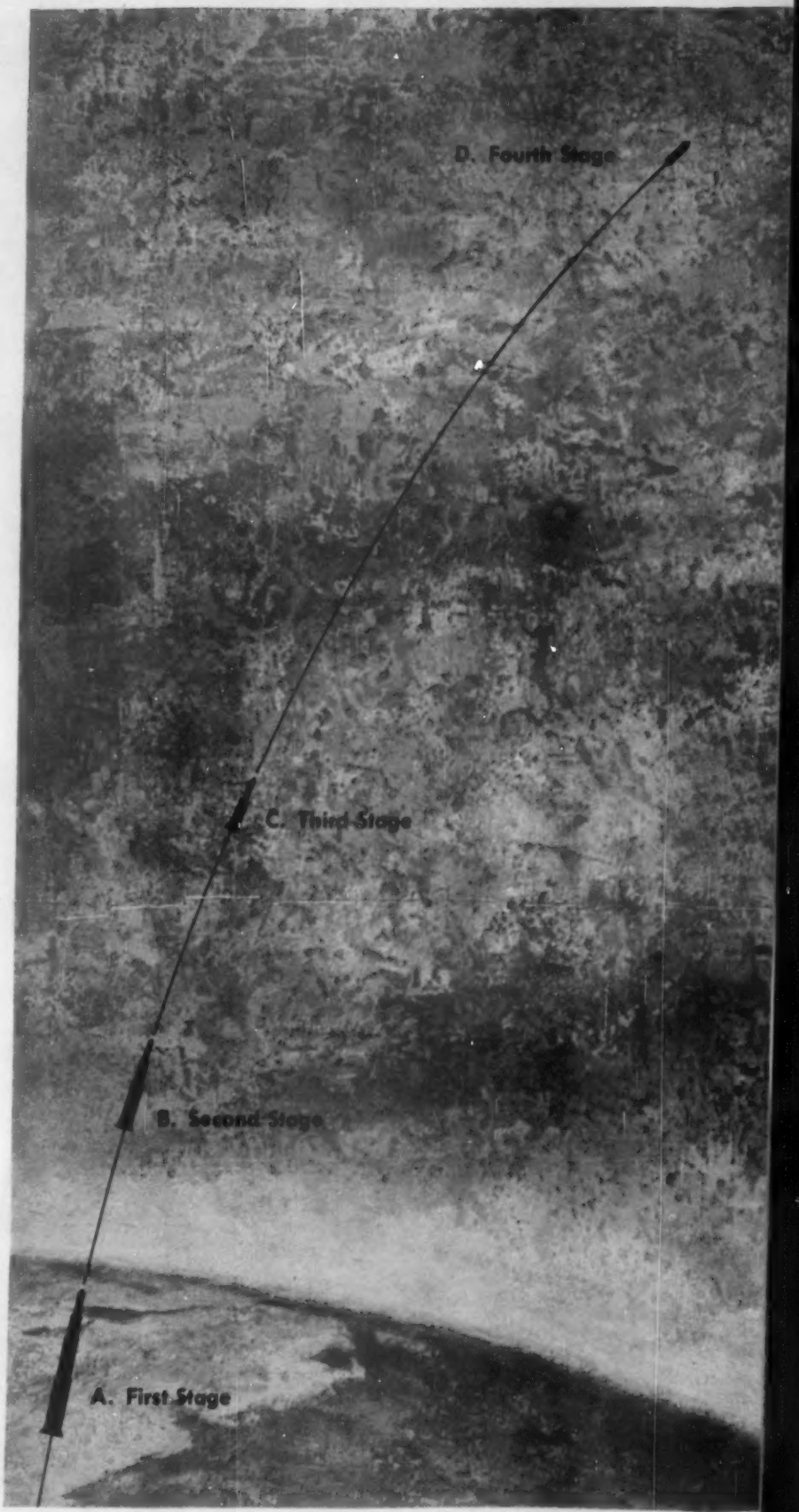
The Honeywell reference system and programmer in the third stage send command signals to the second stage to control its attitude, separation from third stage, and third stage ignition. Second stage attitude control is accomplished by means of an 8-nozzle hydrogen peroxide reaction jet system.

C. Third Stage.

Third stage attitude control is accomplished by means of a two-level, 10-nozzle hydrogen peroxide reaction jet system. The Honeywell third stage inertial attitude reference system and programmer provide command signals to switch nozzles for second stage attitude control. This reference system and programmer also control third stage separation and fourth stage ignition. This third stage also contains associated Honeywell electronic components plus battery supply and inverters. The inertial reference system and programmer can be altered to provide orbits of varying altitudes and ellipticity or can be programmed for various types of high altitude probe missions.

D. Fourth Stage.

In the basic Scout configuration, the fourth stage is rotated by spin rockets to 160 rpm prior to separation from the third stage and ignition. For other missions, the Scout vehicle will include fourth stage stabilization by means of a Honeywell inertial reference package located in the fourth stage.



The ABC's of SCOUT

Honeywell provides complete control system integration for unique new NASA "workhorse" space vehicle

The new NASA Scout, just now making its first penetrations into space, gives the U. S. a multi-purpose vehicle featuring simplicity, reliability and economy. The Scout has been fired twice since July 1, and according to NASA, "guidance and control systems performed satisfactorily on both flights."

To illustrate the flexibility and, therefore, the control problems involved in this Scout program, consider that this solid fuel propelled vehicle is designed for a variety of space missions, putting payloads into these orbits: 80 lbs. at 600 mile orbit, 100 lbs. at 500 mile orbit, and 150 lbs. at 300 mile orbit.

Honeywell engineers analyzed these problems and created a new lightweight, reliable control system that provides the flexibility required for this wide range of missions.

The system uses three orthogonally-mounted precision miniature integrating gyros providing control of pitch, roll and heading. The gyros receive precise torquing commands from the mission programmer to change the vehicle course to correspond with the desired mission path.

With this method of attitude control, great mission flexibility is obtained through simple changes in resistance and timing networks.

Honeywell's system analysis of the vehicle requirements also dictated the selection of hydraulic actuated jet vane and aerodynamic controls for the first stage. Hydrogen peroxide reaction jet systems were selected by Honeywell systems specialists for second and third stage control.

Honeywell backs Scout's guidance and control system with complete ground support equipment for servicing, checkout and launch.

The Scout guidance system program is only one of many in which Honeywell has proven its "quick reaction" system analysis, and design abilities. Other programs include Thor Delta, Discoverer, and Project Mercury. To learn how Honeywell can help solve your system design and integration problems, contact your nearest Honeywell representative, or write Honeywell, Military Products Group, Minneapolis 8, Minnesota.

Engineers and Scientists

Explore the professional opportunities at Honeywell.

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Military Products Group

He solved this puzzle by taking it apart!

Like oil and water, extreme precision and "complete" mobility resist combination in tracking radar antennas. Designing for one of these characteristics "automatically" precludes the other. *That* was this AMF Engineer's puzzle—to put *both* precision *and* mobility in an antenna for duty with the Marine Corps.

He solved the puzzle, literally, by taking apart the solution—AMF's TPQ-10 antenna—into 10 rugged, portable, submersible, precision-fabricated packages. TPQ-10 is designed for helicopter transport. Each component can be dropped in water; it will come up for more. The packaged antenna on its pallet can be dropped on land from 3 feet without impairing precision.

Each component can be *picked* up—the largest weighs 425 lbs.—and can be handled by 3 men. A crew of 6 can put TPQ-10 together in 20 minutes with one standard wrench.

Among the design innovations that solved the puzzle is a "piggyback" gear arrangement that puts both azimuth and elevation drives in one package. Result: almost half the parts and weight of separate components. Precision fabrication is typified by the reflector arms, held to a .005" deviation over 45 inches!

(For unclassified information on early warning and radar antenna systems, write Dept. CS 1, address below.)

Single Command Concept

Solving puzzles with next-to-impossible conditions is AMF's business. AMF's imagination and skills are organized in a single operational unit offering a wide range of engineering and production capabilities. It accepts assignments at any stage from concept through development, production and service training, and completes them faster... in

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- *Weapon Systems • Undersea Warfare*
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December 5, 1960

Aviation Week and Space Technology

Vol. 73, No. 23
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PUBLISHER.....Robert W. Martin, Jr.
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COVER: Bell Aerosystems Co. D-188A V/STOL fighter now is in complete mockup, awaiting government decision on renewed funding for the project. Wing tip nacelles, each containing two General Electric J85-5 turbojets, are positioned for vertical takeoff. Partial mockup of a 5-9 passenger V/STOL aircraft, designed by Bell in response to Air Force interest in a piggyback rescue (AW Nov. 21, p. 23), is in the background.

PICTURE CREDITS

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EDITORIAL

Changing Complexion of Space

Space technology in this country is poised on the brink of major technical and political changes that will radically alter its complexion during the next few years. These changes will have enormous import for the American people as a nation and specifically for the aerospace industry, on which the burden of maintaining our technical pace will fall.

This industry faces the prospect of another period of wrestling with its perennial problems of revolutionary technical changes combined with expanding requirements. An expanding aerospace market for exploratory research and for military and commercial operational space systems is now visible on the near horizon. This market is of a magnitude that would have been labeled "sheer lunacy" if it had been seriously predicted even a few years ago.

These technical and political changes are emerging in an atmosphere that is still heavily conditioned by the continuing success (despite its privately concealed failures) of the Soviet space program. The recent Soviet trio of orbiting capsules containing life support systems offers clear warning that Project Mercury is still waging a long stern chase in the race to put the first human beings into orbit and recover them alive—the first milestone in man's eventual development of space as a useful environment.

The Soviet Sputnik VI (see p. 38) is probably one of the last scientific punctuation marks in the Russian program aimed at putting a two-man orbiting, recoverable space capsule into operation. This effort must be viewed in juxtaposition to the current problems of Project Mercury in checking out complete systems operations, and it certainly presents a radically different and perhaps scientifically sounder approach to the goal of man in space than the Mercury program. If subsequent events prove this thesis valid and the evidence should be available before the end of next year—it will indeed be a bitter pill for this country, and particularly for the National Aeronautics and Space Administration scientists and political midwives who originally conceived the Mercury program and delivered it as the key U.S. space program.

The Approaching Assault

But NASA will not have to wait for the success or failure of Mercury vis-a-vis its Soviet competitors to get the first shock of an external public assault on its present position as the primary custodian of the U.S. space program. The character and scope of this assault have been revealed in clearer detail during recent weeks (AW Nov. 7, p. 21; Nov. 14, p. 26; Nov. 28, p. 26 and on p. 26 of the current issue) as more and more of the technical foundations for an extremely imaginative and broad scope Air Force space system program sifts through its initial security screen.

The USAF proposals offer a far broader utilization of space to radically improve our national defense posture than anything that has been advocated in space technology by NASA or any other organization concerned with this area. Whether this USAF program is technically sound and militarily valid raises questions that will certainly have to be answered in the major debate on this subject that is certain to materialize, both in public and behind the security screen, when Congress returns to Washington next month and a new president is inaugurated.

But from the basic state-of-the-art improvements in virtually every area of the space technology spectrum that are now appearing in early experimental form, it is evident that technically we are still in the early stone age of this historic era. The technical improvements now in prospect offer an enormous opportunity to move forward faster and on a broader front than even the most enthusiastic "space cadets" visualized a few years ago.

A New Look Needed

In addition to the major consideration of properly using space technology to strengthen our national defense posture, these new technical developments in prospect make a major reappraisal of our entire national space program necessary. This reappraisal should include management organization and techniques, possible acceleration of pace, expansion of goals and instillation of a sense of vital national purpose in this program, which is still lacking above the technical working level of government and industry.

In making this reappraisal, there should be no timidity about casting aside some of the jury-rig management techniques and organizational divisions that were hastily conceived in the panicky early post-Sputnik days. This reappraisal also should be inoculated against the virulent attacks of budgetitis that have badly crippled the space program in its formative years. The budgetary problems of an adequate space program are genuinely formidable, but they should be approached with the viewpoint that this is high risk capital being staked on the major, revolutionary advances in technology that can pay substantial dividends militarily, economically and politically in the future of this nation. There must also be an adequate prescription against the overdoses of technical conservatism that are no longer justified in view of the experimental achievements of the past year and the rosy glows already appearing on the technical horizon.

This major reappraisal of the national space program, which is approaching as inevitably as the turn of the year, cannot be allowed to degenerate into the petty bickering of another inter-service or inter-departmental rivalry for the major slice of a budget pie. It must be undertaken with the firm resolve that this is one of the most significant efforts in our national history and with the understanding that its results will determine in large measure our stature as a nation in the history that unfolds during the last half of this century.

—Robert Hotz

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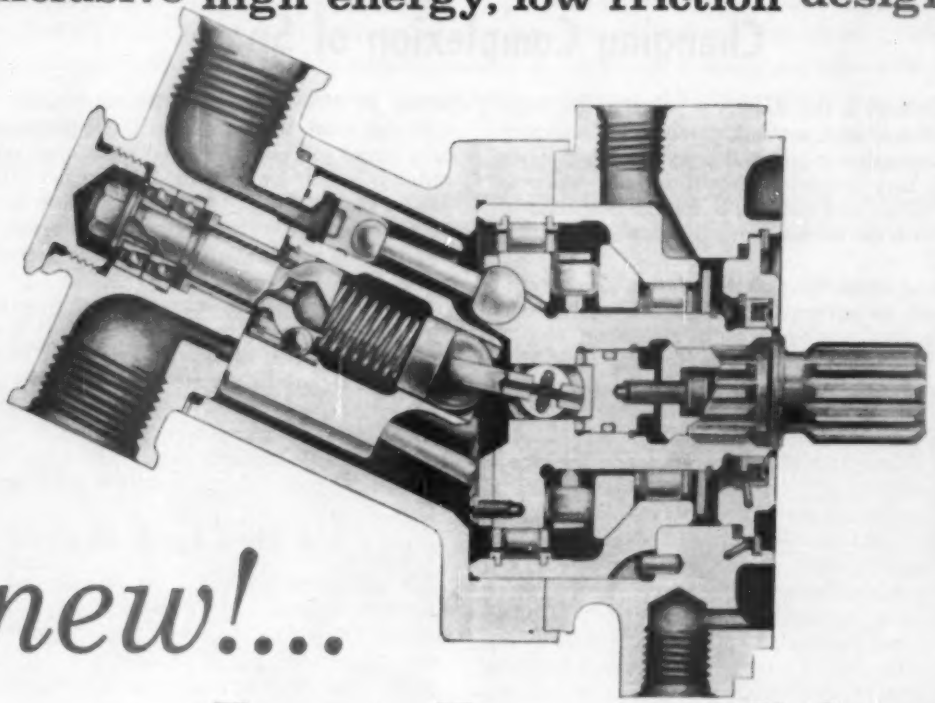

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In the Front Office

Dr. Gordon S. Brown, Dean of Massachusetts Institute of Technology's School of Engineering, elected a director of Baird-Atomic, Inc., Cambridge, Mass.

Donald W. Douglas, Jr., board chairman, Astropower, Inc., Long Beach, Calif. (see AW Nov. 7, p. 30). Other directors are: **Y. C. Lee, Dr. George Moe, Edward W. Smith, John A. Dundas, Charles R. Able** and **Elmer P. Wheaton.**

Ernest L. Ward, president, Sprague Electric Co., North Adams, Mass., succeeding the late **Julian K. Sprague.** The company also appointed the following senior vice presidents: **William J. Nolan**-legal affairs; **Neal W. Welch**-marketing and sales; **Wilbur A. Lazier**-technical director; **Robert C. Sprague, Jr.**,-industrial relations. Appointed vice presidents: **David B. Peck**-special products; **Hollis R. Wagstaff**-fiscal; **Carroll G. Killen**-industrial and military sales; **Bruce R. Carlson**-corporate planning and systems.

Eugene G. Hart, president, International Research and Development Corp., Worthington, Ohio.

Odif Podell, vice president-operational planning, Curtiss-Wright Corp., Wood-Ridge, N. J.

Keith T. Middleton, executive vice president, the Fafnir Bearing Co., New Britain, Conn. Also: **Beecher N. Claflin,** assistant secretary; **Edwin A. Ingbretsen,** assistant treasurer.

H. George LeClerc, vice president-manufacturing, Link Division of General Precision, Inc., Binghamton, N. Y.

Canadair, Ltd., Montreal, Canada, has announced the following appointments: **Frederick R. Kearns,** executive vice president-sales and finance; **John Urwin,** vice president and secretary; **John B. Hunter,** comptroller; **Theodore C. Pawlett,** treasurer.

Dr. Charles F. Robinson, a vice president of Consolidated Electrodynamics Corp., a subsidiary of Bell & Howell, **Pasadena,** Calif. Dr. Robinson continues as director of the Bell & Howell Research Center.

William E. McKenna and **Crosby M. Kelly,** vice presidents, Litton Industries, Beverly Hills, Calif. Mr. McKenna continues as treasurer and controller, and Mr. Kelly in charge of advertising, public relations and employe communications.

Curtis R. Hammond, commercial vice president-market development, Raytheon Co., Waltham, Mass.

Maj. Gen. Robert H. Booth, USA, Chief of the Defense Atomic Support Agency, Washington, D. C., succeeding **Vice Adm. Edward N. Parker,** USN.

Honors and Elections

Dr. R. R. Jamison, assistant chief engineer and head of the Ramjet Department of Bristol Siddeley Engines, Ltd., has been awarded the Swedish Society of Aeronautics' Enoch Thulin Bronze Medal in recognition of the work of the Bristol Siddeley ramjet design team and of the company's achievement in the field of supersonic propulsion.

(*Continued on page 119*)

INDUSTRY OBSERVER

► Air Force will use Lockheed C-130s for air recovery of the Samos reconnaissance satellite re-entry package, which is too big for Fairchild C-119s to handle. Five Samos shots are scheduled before the first recovery attempt, now planned for next September. The 6593rd Test Squadron expects to get is first C-130 about Jan. 1, and conversion from nine C-119s used for Discoverer recovery to a fleet of five C-130s is to be completed next spring.

► NASA's Echo II passive communications satellite probably will be 140 ft. in diameter, an increase over the size of the 100-ft. Echo I sphere. Echo II inflatable sphere is expected to use sandwich construction to give it increased rigidity.

► Convair F-106 interceptor will be used as a chase plane for the Mercury-Redstone flights. F-106 will monitor the launch and terminal phases. National Aeronautics and Space Administration originally considered the Lockheed U-2 for the chase role (AW Nov. 21, p. 27).

► Ultraviolet terminal guidance system with all-weather capability for ballistic missiles has been proposed to the Air Force by Avco's Research and Advanced Development Division. Ultraviolet systems, operating at the opposite end of the light spectrum from infrared systems, have a number of possible applications, including aircraft navigation displays.

► Proposals are due today for a spectrum surveillance system capable of monitoring all frequencies radiated at Air Force Missile Test Center's launch site at Cape Canaveral, Fla. System is to analyze frequencies and their nature and origin, in an effort to track down and eliminate sources of electromagnetic interference with operation of missile avionic gear during checkout and launch.

► Australian technical evaluation favors the Dassault Mirage III for the RAAF fighter role if modifications are made to give the French fighter a 1,500-mi. range. With the technical evaluation complete, final decision between the Mirage III and the Lockheed F-104, including financial considerations, now can be made.

► Recent Navy briefing on purpose and future of the Transit satellite system, held by Bureau of Ships, Bureau of Weapons and Johns Hopkins Applied Physics Laboratory (AW Oct. 17, p. 23), was attended by about 80 companies. It was not a formal bidders briefing, but requests for proposals for shipboard digital equipment to process navigation data from Transit system probably will be issued within 60 days, possibly without a formal briefing. Navy indicated it does not want to sponsor separate computer development for this use.

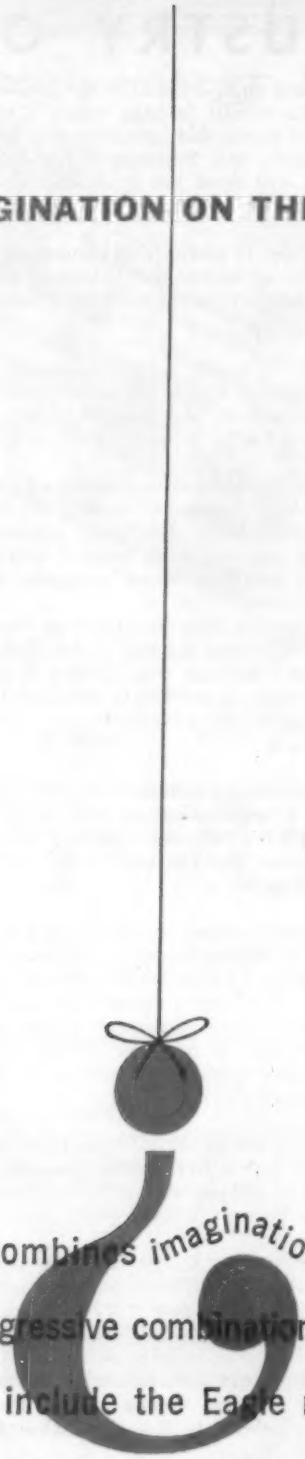
► First aircraft-missile compatibility flight test of the Air Force-Douglas Skybolt air-launched ballistic missile, originally scheduled for this month, now has slipped to mid-January. A B-52 will carry four dummy Skybolts on test flights from Boeing's Wichita plant.

► Philippine air force is considering the Lockheed F-104 and Convair F-102 as replacement for its North American F-86s. F-102 is favored because of its all-weather interceptor capabilities. Availability of Mutual Defense Assistance Pact funds will be a major factor in any equipment change.

► British Blue Steel air-to-surface missiles are being shipped to Australia for test flights over the Woomera range from Royal Air Force V-bombers. Missiles are airlifted by Royal Australian Air Force in C-130s.

► Switch to a reverse flow nozzle could cut the present 16-ft. height of the 1.5 million lb. thrust Rocketdyne F-1 engine to about 2 ft. Vehicle length has replaced diameter as the major size problem with such large vehicles as Saturn and the proposed Nova, which would be powered by the F-1. Increased bending moments are the basic concern. Squat configuration of the reverse flow nozzle is its primary sales appeal, although efficiency is slightly below that of the longer bell-shaped nozzle.

IMAGINATION ON THE PROWL



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Washington Roundup

Military Space Ferment

An expanded military space program is almost certain to result from the combination of legislative and executive department changes expected during the early days of the Kennedy Administration—but not until after the dust has settled around some bitter skirmishes on Capitol Hill.

Reorganization of the Defense Department, which includes the outside possibility that all military research and development will be put under one agency, may have to be argued out first.

Air Force has the most ambitious plans for growth (see p. 26), and has laid its groundwork carefully. It has support for at least some of its ideas from Vice President-elect Lyndon Johnson, who will be a powerful factor in the Administration's space decisions.

Both the Senate and House space committees have shown sympathy in the past for the services' dilemma—having the responsibility for space defense systems but being dependent on the National Aeronautics and Space Administration for much of the supporting technology.

The House committee has asked each service **for detailed compilations** of all current and projected space programs. They are due this week.

Budgets of the military services for Fiscal 1962 will total only about 2.5-3% above the current year by the time Secretary of Defense Thomas Gates submits them to the Budget Bureau next week. Orders for most of the cutting and reshuffling apparently originated with Dr. Herbert York, director of defense research and engineering. In an unexpected turnabout, York got stiff opposition on a number of cuts from John Rubel, the man who filled his post while York was ill recently.

Space Council Revival

After almost a year of inactivity, the National Aeronautics and Space Council may be reactivated. It was created by the national space act, partly at the insistence of Lyndon Johnson, specifically to place responsibility for the space program unmistakably at the presidential level.

President Eisenhower asked last January that the Council be abolished. Permanent staff was never appointed, and even when the Council held meetings last year, it did not function as Congress intended.

Kennedy wants closer contact with departments than Eisenhower had. The Council, which brings together the Secretaries of State and Defense, the heads of NASA and the Atomic Energy Commission and others, is an ideal vehicle. Johnson himself probably would sit in on meetings.

A Dec. 15 deadline for presentation of industry's views on renegotiation has been set by the House Ways and Means Committee. Response is varying from the opinion that any presentation is futile to plans for vigorous opposition to the Renegotiation Act in its present form. Aerospace Industries Assn. plans to appoint a task force to negotiate an industry-wide position.

Key amendments urged by AIA last year were rejected, and Congress extended the act until June 30, 1962. The extension law required Ways and Means to make a study and submit recommendations by next Mar. 31.

Senate Studies CAB

Senate Commerce Committee's staff study on the Civil Aeronautics Board and other regulatory agencies, under way since last August, puts its emphasis on reduction of the constantly increasing backlog of cases.

General Accounting Office is making a thorough pilot study of Interstate Commerce Commission, at the request of Chairman Warren Magnuson (D.-Wash.), with the intent that findings will be applicable to other quasi-judicial agencies.

GAO's report is expected early in January, and committee hearings are expected to be held early in the next Congress.

Air Force is making a concerted effort to show that its Minuteman missile system is 25% cheaper than the Navy's Polaris. Navy claims its cost figures include everything down to bus transportation for the crew to and from the submarine. It says the Air Force makes its own accounting rules, ignoring site costs.

Lt. Gen. Robert J. Wood has labeled the Nike Zeus anti-missile missile a "terra-space weapon." Wood, head of the Army Air Defense Command, says this means it has its feet on the ground even though it kills targets that are way out.

Westinghouse will develop a high energy arc heater for NASA under an unusual $300,000 contract that will cost NASA nothing unless the heater—a scale-up of an existing model—meets guaranteed performance.

—Washington Staff

Air Force Outlines Broad Space Plans

USAF prepares to fight for space policy changes to pave the way for a variety of weapon systems.

By Larry Booda

Washington—Air Force is preparing a major political offensive to bring about changes in national space policy and law that would let it proceed with detailed, specific plans for space weapon systems involving "tens of thousands, perhaps hundreds of thousands" of satellites in orbit in the next 15 years.

In the latest of a continuing series of technical briefings to industry leaders and groups within the service, Air Research and Development Command's Ballistic Missile Division has claimed that Air Force has offensive, defensive and logistic missions to perform in space. "Military space," defined as space out to 10 earth diameters, is the battleground of the future, USAF says.

Air Force bases its position on the results of a number of funded and unfunded studies, completed by itself and industry over the past three years, in briefing Defense Department policymakers and in preliminary defense of its arguments for the next session of Congress.

Congressmen in key committee posts and their staffs already have received informal briefings. They have been told that Air Force's plans for future military utilization of space are far more imaginative and complete than those of the Office of the Secretary of Defense and the National Aeronautics and Space Administration.

Air Force is basing its claim to a broader space role on the language of the National Aeronautics and Space Act of 1958. This act charges the civilian space agency with making "adequate provision" for aeronautical and space activities.

But is also says: ". . . except that activities peculiar to or primarily associated with the development of weapon systems, military operations or the defense of the U. S. [including the research and development necessary to make effective provision for the defense of the U. S.] shall be the responsibility of, and shall be directed by, the Department of Defense . . ."

The argument advanced by Air Force is that it cannot fulfill its portion of the space defense mission without clearer recognition at the top official levels of its need to pursue a broader research and development program on space systems.

Until now, policy based on the space act has given NASA the responsibility for manned space flight and development of large boosters. Air Force wants to see this policy changed to allow it to perform both tasks as necessary to carry out its own missions, regardless of what the civilian agency does.

With Congress opposed to duplication of effort, Air Force obviously can broaden its own space efforts only so far before it begins to compete with NASA for the same budget dollars.

Not only does Air Force expect to invade a province of NASA by proposing manned space vehicles and large booster development, but it intends to enter the communications satellite development area, now monitored by the Army.

Navy, too, is the butt of pointed remarks in the USAF briefings on the subject of the submarine-launched Polaris missile. Briefers claim it will be ineffective after 1964 (see p. 25).

Systems already in development or proposed by USAF for its expanded space program include:

- **Offensive**—Positive Control Bombardment System (PCBS), sometimes called Recallable Intercontinental Ballistic Missile; and truck-mounted ICBM, sometimes called Midget Man.
- **Defensive**—Spad, Random Barrage and Insatrac.
- **Logistics**—Satellite Maintenance and Repair Techniques (Smart) and Military Space Launching System (Phoenix). Space Plane (AW Oct. 31, p. 26), was not included in the briefings.
- **Reconnaissance**—Samos photographic satellite, Midas infrared ICBM launching detection satellite, and Saint satellite orbital inspector (see p. 27).
- **Communications** – Communications Satellite, Advanced Research (Csar), which until recently was called Fixed Link Aerospace to Ground (Flag).

In stating general aims, briefers have emphasized that the U. S. must possess more ICBMs than Russia and must continually strive for superiority in this extension of strategic warfare.

It is desirable to reduce launching costs, briefers said, so that systems involving tens of thousands of satellites will not be prohibitively expensive. Launch costs, which are now on the order of thousands of dollars per pound of payload, must be brought down to $100 or even $10 per pound. Launching should be as common as Boeing B-52 takeoffs and comparable in cost.

Additional objectives are to increase satellite life by improved component reliability and better space power supplies.

Maneuverability in flight will be a standard requirement for all new ballistic missiles and satellites.

Positive Control Bombardment System, or Recallable ICBM, would involve three-ton, missile-armed satellites orbiting at 100 naut. mi. altitude. From such an orbit, re-entry trajectories of the missiles could be varied to permit attacking a target from distances of a little more than 5,000 naut. mi. to as much as 16,000 naut. mi. This would be accomplished by varying the injection angle from orbit.

There would be an 18-min. line-of-sight period during each pass of the satellite when it could accept a command. On receiving a command, the vehicle would reorient for re-entry, fire its retrorockets at the programed time, separate the one-ton-plus re-entry vehicle from the satellite, and the re-entry vehicle would proceed to the

Transit Launch Fails

Cape Canaveral—Navy Transit III-A navigation satellite failed to reach orbit last week when the Thor booster failed after several minutes of flight and the range safety officer had to destroy the vehicle.

Cuba reported that about 40 lb. of fragments fell in an uninhabited area near the eastern end of the island. Defense Department said it "could not exclude the possibility" that parts of the destroyed vehicle fell in Cuba.

Navy navigation satellite test vehicle was to have been launched into a 500-naut. mi. circular orbit. Basic Transit III-A satellite weighed 203 lb., and it carried a 40-lb. piggyback satellite which was to have measured radiation (AW Nov. 7, p. 57).

Two successful launchings of Transit vehicles were made in April and June. Transit I-B has ceased transmitting, probably due to a faulty switch designed to control battery recharge. Transit II-A is transmitting and providing information on the ionosphere. There was one previous failure when Transit I-A second stage did not ignite for final injection into orbit.

RCA Will Develop Saint Payload

Washington—Radio Corporation of America has been chosen to develop the final stage and inspection payload for the Saint satellite rendezvous and inspection system.

Payload will weigh nearly two tons and will carry a homing radar and television camera for intercepting unknown satellites for identification purposes (AW Nov. 14, p. 26). Saint will be launched from Cape Canaveral by an Atlas booster, and it will be injected into orbit by an Agena B second stage.

Initial contact with the unknown satellite will be from above and ahead by less than 50 mi. Retrorockets will slow Saint to produce an initial closing rate of 3,500 mph., which will be reduced to less than 10 mph., as the Saint vehicle comes within about 50 ft. of the target.

Demonstration launches are scheduled to begin in December, 1961. These launches, which will continue at the rate of one every three months until September of 1963, will be directed against reflectors or 25-ft. balloons previously launched into 400-naut. mi. orbits.

RCA contracts will total $28 million of about $50 million budgeted for the first system development effort. Work will probably be divided between the Missile and Electronics Controls Division at Burlington, Vt., the Airborne Systems Division at Camden, N. J. and the Astro-Electronics Division at Princeton, N. J. This project will mark the first RCA development of a complete missile or satellite system.

Eight vehicles will be built, four intended for orbital tests. Of the remaining four, one will be used for type testing in an environmental chamber, one will be a spare at Cape Canaveral, one will be used for full power ground rocket test and one will be an engineering model for a realistic mockup.

First four test vehicles will weigh about 2,200 lb. Operational vehicles may be double that weight.

Feasibility demonstrations will be attempted under a set of conditions offering the greatest chance of success. Targets will be orbiting in the same plane as the Saint vehicle since both will be launched from Cape Canaveral.

Any future operational system would have to have dog-leg capability to alter the orbital plane of the inspection vehicle sufficiently to make an interception with closing speeds within design parameters.

Program will be managed by the Ballistic Missile Division of the Air Research and Development Command, while technical supervision will be under Aerospace Corp. Military support will include the National Space and Surveillance Control Center at Cambridge, Mass., which will coordinate the tracking, the 6594th Missile Test Wing at Sunnyvale, Calif., and the 6555th Missile Test Wing at Patrick AFB, Fla.

target and detonate its warhead.

The recallable feature is the provision that, if at any time during the command interval the final attack signal is not received, the vehicle will automatically discontinue its preparation for re-entry to the original target. It will then re-enter over a preselected remote sea area, render its warhead inert and descend into water.

Minuteman Trucks

With development already under way for placing Minuteman ICBMs aboard railroad trains, Air Force plans to add further mobility to ballistic missiles by mounting them on trucks. A 30-ton truck would carry a 12-ton missile. Guidance would be by inertial package or radio command.

Navy Polaris and Army Pershing II have been offered for NATO use in limited war. Air Force is entering this field with a proposal for another Medium Range Ballistic Missile (MRBM) carrying a low-kiloton range warhead.

In the realm of logistics, the Smart concept, for Satellite Maintenance and Repair Techniques, encompasses four general methods of accomplishing the repair of inoperative satellites or those that are not operating properly. They are:

- **Total replacement of the satellite,** considered the most expensive inasmuch as it involves another launching.
- **Rendezvous with the capsule** by a manned "repair ship" and maintenance on contact.
- **Manned satellite** with a crew to maintain it in working order. Crew replacement would be done by utilizing space ferry.
- **Manned space station** carrying several space satellite payloads.

Studies have indicated that regular maintenance is mandatory because no components can be manufactured with infinite life. Failure rates have been assigned carbon resistors, germanium diodes and transistors, paper capacitors and inductors. Transistors and diodes have the shortest life expectancy, but by building in redundancy, these components can be made to match the lifetime of others. Regular maintenance still will be necessary, USAF believes.

Expanding its interest into the field of big boosters, Air Force has established Project Phoenix, or Military Space Launching System. Booster would have 800,000-lb. thrust and would be capable of putting manned satellites into orbit.

Phoenix is a sort of over-all approach to reduction of space launch costs through recovering and reusing boosters and launching from installations at sea. System development is planned to begin in 1961, with the first launch planned for 1965.

Mother Ship

Space Plane would be a type of mother ship. This 500,000-lb. vehicle would take off aerodynamically with an initial load of liquid hydrogen and then fly in the outer fringes of the atmosphere. While flying there it would gather air through a venturi system, compress and liquefy it and fractionally distill it to get liquid oxygen. After this cycle the vehicle would weigh one million pounds and could proceed on its logistic or exploratory mission.

A variation of this concept has the vehicle operating as a space command post to direct military operations in orbital areas or stationed even in deep space.

In the area of defense against ICBMs, called AICBM, the basic Air Force idea is to intercept these missiles shortly after their takeoff from a launching pad or silo. This would be done by satellites.

There are several ways to accomplish the interception and kill. One is to have a carrier satellite which would release missiles to make the kill. Another is the "do it yourself" type, which would make the interception and kill on its own initiative.

In any case the missile must be detected immediately after it rises above a cloud layer. In such a system the time element is compressed to the extent that only a few minutes are available for detection, interception and kill. Interception should be made before burnout of the booster.

Random Orbits

One approach is that studied by Convair, called Spad (AW Oct. 31, p. 33). This concept calls for 2,000 to 3,000 satellites in random orbits at about 200 naut. mi. altitude. Each satellite would carry from one to six missiles which would be launched for interception and kill. Detection capability would be built into the vehicle.

Another study, conducted by Thompson Ramo Wooldridge and called Random Barrage, would involve 20,000 to 100,000 units in random orbits. In this system the satellite itself would make the kill. This missile is designed as a simple one with no moving parts. Each

one would have a mean time of two years before failure.

Lockheed's Insatrac system would be a follow-on to the Saint inspection satellite, which is designed to determine the nature of unknown satellites. Insatrac's capability would include maneuverability to make more than one pass. Another concept would also give it the destruction capability.

If any of the AICBM systems are approved, development will begin in 1962, with an initial operational capability by 1965 and deployment by 1967.

In considering any future combat capability, ARDC planners say that a military communications satellite system is essential. Csar—formerly Flag—would augment Army's Advent communications satellite.

Csar is described as a synchronous 24-hr. communications satellite suitable for long range strategic communications. It should be developed in time to be ready to operate along with the operational systems described above.

One Csar satellite would be stationed above the equator near the mouth of the Amazon River and another near Christmas Island in the Pacific.

Power would be from solar cells. Vehicle would weigh about two tons. For wartime operation it would be capable of operating several duplex voice channels through all known jamming techniques. In peacetime, hundreds of voice duplex channels or 10 times as many teletype channels and one broadband channel for television or facsimile could be handled. Operation would be by three transmitters and three receivers covering a band from 3,000-8,000 mc.

Tiros II Has Wide-Angle Camera Trouble

Washington—Tiros II weather satellite is providing excellent infrared data, but scientists doubt that performance of the wide-angle camera will improve much beyond its current 5-10% usefulness.

Although initial operation of the system showed high promise (AW Nov. 28, p. 32), the wide-angle camera apparently was jarred out of focus at launch, staging, or possibly by being struck by a de-spin weight.

The early difficulty in the camera was believed to have resulted from a high power drain at launch, and the situation was expected to be corrected by functioning of the solar cells. After a week of operation, with 160-170 cloud cover pictures transmitted daily, the trouble was believed to be in camera focus.

Although Tiros is an experimental vehicle, the problems and benefits created by an operational weather satellite are being investigated by feeding Tiros data into standard meteorological communication channels for use in regular forecasts. Meteorologists in the program estimate that it is now taking between two and three hours to reduce Tiros data and make it available to forecasters. This time should become shorter as experience increases.

Tiros readout stations at the San Nicolas Island station of the Pacific Missile Range and at the Ft. Monmouth, N. J., Army Signal Laboratory collect raw data telemetered from the satellite. Information collected by the 60-ft. dish antenna on San Nicolas is relayed directly by microwave data transmission system to the meteorological analysis center at Pacific Missile Range headquarters, Pt. Mugu. Infrared readings of the earth's albedo taken by Tiros are teletyped from Pt. Mugu to Goddard Space Flight Center, which directs Tiros II operations.

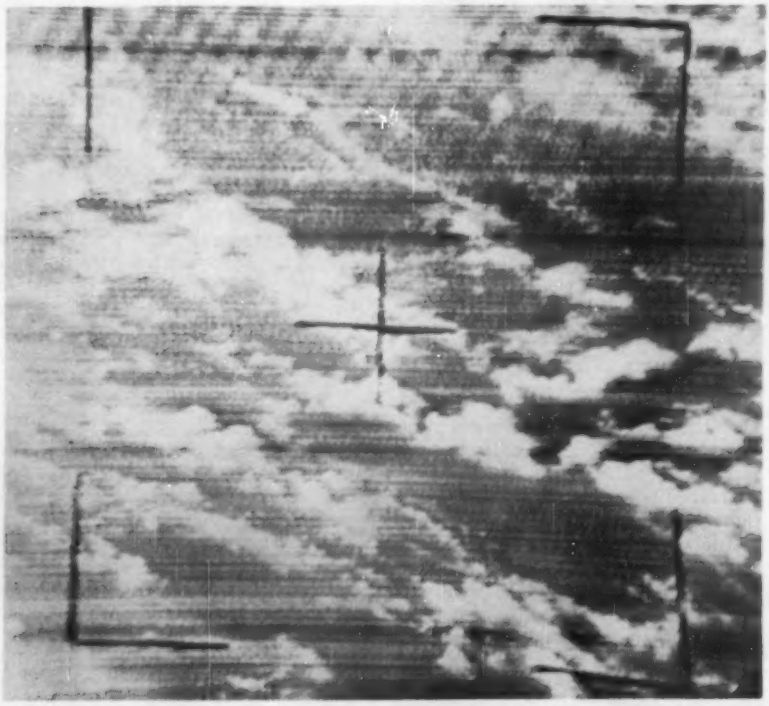
Cloud photographs televised from the satellite, recorded on video tape at San Nicolas and retransmitted to Pt. Mugu are analyzed there and plotted on standard charts called nephanalyses for facsimile transmission to the U.S. Weather Bureau meteorology satellite section, and to Navy and USAF air weather services via the National Meteorological Center at Suitland, Md., and to the U.S. Pacific Fleet via Fleet Weather Facility, Alameda, Calif.

Analysts and forecasters are using a manual prepared by the Weather Bureau showing cloud pictures taken from Tiros I compared with cloud pictures taken from the ground. The nephanalyses will be used in preparing forecasts over a large part of the northern hemisphere.

Photo enhancement techniques are being used to extract as much useful data as possible from the pictures, since the wide-angle camera furnishes photographs which permit fast orientation when used with data from the narrow-angle camera. Photos from the narrow-angle camera are considered about 85% useful.

Two days after launch, two of five pair of spin rockets were fired on ground command to increase stabilization spin rate and eliminate a wobble. Atlantic Research Corp. rockets increased spin from 8 to 10.8 rpm. on the first firing, and to 13.9 rpm. on the second.

Despite a malfunction in one camera, the Tiros II satellite provided the basis last Monday for cloud charts which showed movement of a storm which brought the season's first snows to the Midwest. Charts also showed heavy seas in the North Atlantic and northeasterly movement of a large low pressure area.



TIROS II's narrow-angle camera transmitted this photo of cloud formation when the orbiting satellite was northeast of Los Angeles looking west at the California coastline, which is obscured by the clouds. Photo, taken on 78th orbit, was received by the Tiros II tracking station at Pt. Mugu, Calif. Photo was transmitted at 11.25 a.m. PST on Nov. 28.

Decision Near on NATO Nuclear Weapons

By Cecil Brownlow

Paris—Final decision to accept, reject or adopt in part Gen. Lauris Norstad's proposal to make the North Atlantic Treaty Organization the world's fourth nuclear power probably will be delayed until the annual defense ministers' meeting here in March. The reasons are twofold:

• **Annual ministerial meeting** beginning Dec. 16 is expected to broach the matter as to its over-all political implications but withhold any final judgment in order not to give the appearance that the matter was decided purely on political, rather than military, merit.

• **Despite attendance by** Vice President-elect Lyndon Johnson at the recent sixth annual NATO parliamentarians' conference here—where Norstad, supreme allied commander in Europe, made his proposal—and Johnson's subsequent assurances that U. S. backing for the organization will continue full-force under the new Administration, endorsement of the plan by Kennedy after he has assumed office is felt necessary before formal approval can be given—or necessary votes mustered.

West German Support

The strongest backer and the nation with the most to gain is West Germany, whose program for a 1,000-plane combat jet air force by the mid-1960s will make it the strongest force on the west European continent. This force hardly can be effective in full-fledged combat unless nuclear weapons are immediately available. Success of the present cumbersome concept of fast logistic supply from central depots and substitution of atomic warheads for the conventional systems now in place after any earnest strike from the east has taken place is problematical, to say the least, in the view of western military commanders.

On the other hand, any direct proposal to grant the Germans as a national force—which they insist they are not—use of nuclear weapons would create the immediate possibility of unresolvable debates in most west European capitals and probably the United States itself. The Germans are careful to point out that their forces—air, ground and sea—are NATO, not West German per se, and under the NATO "fourth power" concept, nuclear weapons probably could be made available "on site" with a minimum of political criticism or debate. West German pilots already are being trained in nuclear delivery techniques at a special weapons training site outside Germany.

Aside from Kennedy Administration approval, the proposal would, of course, require congressional approval for a change in the existing law that demands that nuclear warheads remain under the control of U. S. forces before any full implementation of ideas expressed by Norstad is possible.

Pressures for Approval

Pressures for such approval will be strong, however, as the west European nations—particularly Germany, Italy, Holland and Belgium—prepare for introduction of the Lockheed F-104G as a supersonic fighter-bomber delivery system. For maximum effectiveness against all-out attack, the F-104 as a fighter-bomber staged in areas near the eastern border requires immediately available atomic weapons. The time needed to transport them from United States-controlled supply depots probably would not be available.

Norstad, in laying the groundwork for the proposal, told the parliamentarians' conference that under the present depot system "you will find in almost every major allied command some units which can deliver atomic warheads." He added, however:

"Under the NATO atomic stockpile system, provision is made for supplying the combat units with nuclear components when the situation demands, and after a decision has been made to do so. But until that time the components themselves are retained in the strictest custody of the country of original source of ownership. Therefore the needs of NATO do not serve to enlarge or expand the number of independent authorities having control of atomic warheads."

Emphasizing that he was speaking "for myself," and pointing out the need for legislative changes for its effective implementation, Norstad listed his fourth-power proposal as the third of three "distinct areas for consideration" in enhancing NATO effectiveness.

He said: ". . . A great and new question has arisen within the Alliance: How do we meet a growing desire for a broader sharing in the control of nuclear weapons? How can the Alliance as a whole be assured that such weapons will be available to it in all reasonable circumstances for its defense, for the defense of Europe? These questions need to be carefully considered by the Alliance. The forces which are assigned to the NATO mission require the support of nuclear weapons. The defense of Europe against a serious large-scale attack certainly depends on these weapons. A search for a fair solution to the problem of sharing and control is thus of the most vital concern to all of us."

Taking pains to explain that "it is quite obvious that I, as a military man, am in no position to insist on a particular specific solution to what is overwhelmingly a political problem," Norstad continued:

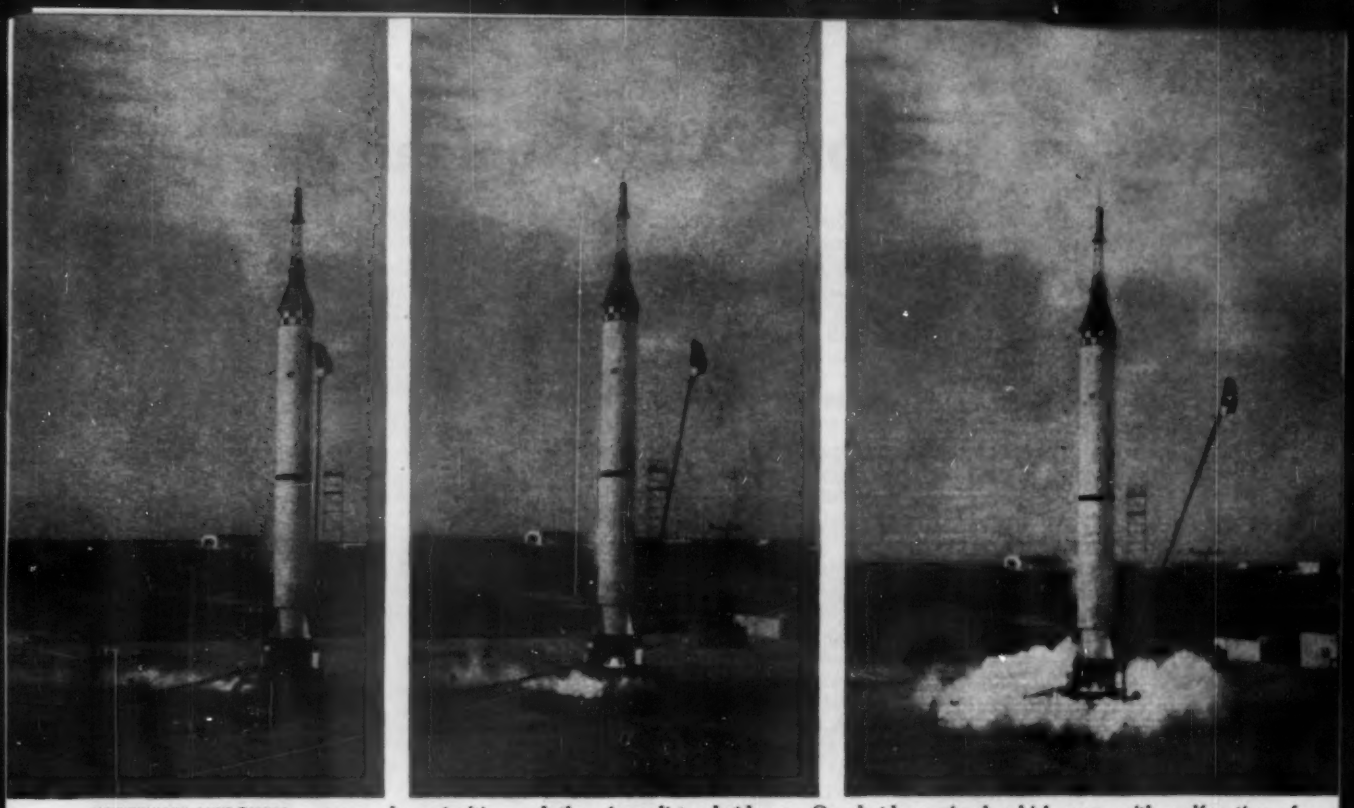
" . . . Many ideas have been advanced for dealing with these questions. It has been suggested, for instance, that the control of weapons might be passed to the Alliance so that they might be committed to NATO for the life of the Alliance in its present form. When I speak of weapons, I am speaking not of the aircraft or the missiles or the guns which deliver the warheads; but I am speaking in this sense of the nuclear component's which are now retained in the strictest custody [by the United States]. It cannot be assumed that the creation of a multilateral atomic authority, making NATO a fourth atomic power, as has been expressed, would necessarily influence the desire of some nations [notably France] to pursue their own independent quest for an atomic weapons capability. However, such action might very well satisfy the desires and interests of others by meeting fully the military requirements and by assuring an equal voice in the control of the particular pool of forces which could be established as essential to the direct defense of Europe."

Norstad concluded his proposal with the statement that "if politically feasible, action to pass to the Alliance greater control over atomic weapons and to subject their use more directly to the collective will could be a great and dramatic new step."

Proposal Made Previously

Norstad had earlier outlined his proposal in almost identical words last December in a speech at the Institute of World Affairs sponsored by the University of Southern California in Pasadena in what may have been a trial balloon to test public and political reaction in the United States.

Two proposals preceding his fourth nuclear power suggestion at the NATO parliamentarians' conference included the necessity for modernization with the introduction of medium-range ballistic missiles, "which first gave rise to discussions of the Polaris, for instance," and "heavy strategic retaliatory forces." As to the latter, Norstad said: "This , is an extremely interesting thought but one which has not, to my knowledge, been proposed by or within the Alliance. It has not been suggested by me, or my headquarters."



REDSTONE-MERCURY sequence shows ignition and then immediate shutdown. On shutdown signal, which came with malfunction of

Second MR-1 Test Planned in Two Weeks

By Edward H. Kolcum

Washington — Mercury-Redstone I (MR-1) launch attempt will be repeated in about two weeks with electrical ground connections altered to eliminate the abnormal power disconnect timing which shut down the booster engine just after ignition in the initial MR-1 attempt.

Recent MR-1 test (AW Nov. 28, p. 28) was the third successive launch failure in the Mercury program. Previously, the Atlas-boosted MA-1 and a Little Joe flight failed.

Although National Aeronautics and Space Administration has yet to fly a rocket-boosted production capsule, Mercury project managers were heartened by the flawless performance of the capsule during the abortive Redstone test. The undamaged capsule followed each signal it received. It will be fitted with new escape tower and parachute recovery systems, which were activated during the Redstone test, and it will be flown as MR-1 on the same mission planned for the launch that failed.

Mercury Director Robert R. Gilruth estimates that the Nov. 21 failure will delay the program a matter of weeks, and it will have no significant effect on program cost since both the capsule and booster involved eventually will be flown. Gilruth said that a manned Redstone ballistic flight will be made early next year, and the manned, Atlas-boosted orbital mission will be launched before the end of 1961.

The MR-1 booster will be new because the Redstone used in the initial attempt lifted 0.25 to 0.5 in. before dropping back on the pad, and it was shipped back to Marshall Space Flight Center for a structural check.

Early Disconnect

Dr. Joachim P. Kuettner, Mercury project chief at Marshall, traced the launch malfunction to early disconnect of the power plug, one of two electrical ground connections to the booster. Power and control plugs, programed to disconnect simultaneously, actually pulled loose with a time differential of 20 milliseconds. Power plug is used to ground the missile and negative side of the battery, and with the booster not grounded, the control circuit put out a voltage resistance which closed the cutoff relay and shut down the engine. Power plug also was found to be ¼ in. shorter than the control plug, and this could have resulted in a slightly early disconnect.

Kuettner said the situation is being corrected by lengthening cables to assure that the booster will remain grounded until the control plug is disconnected, and by making both plugs the same size.

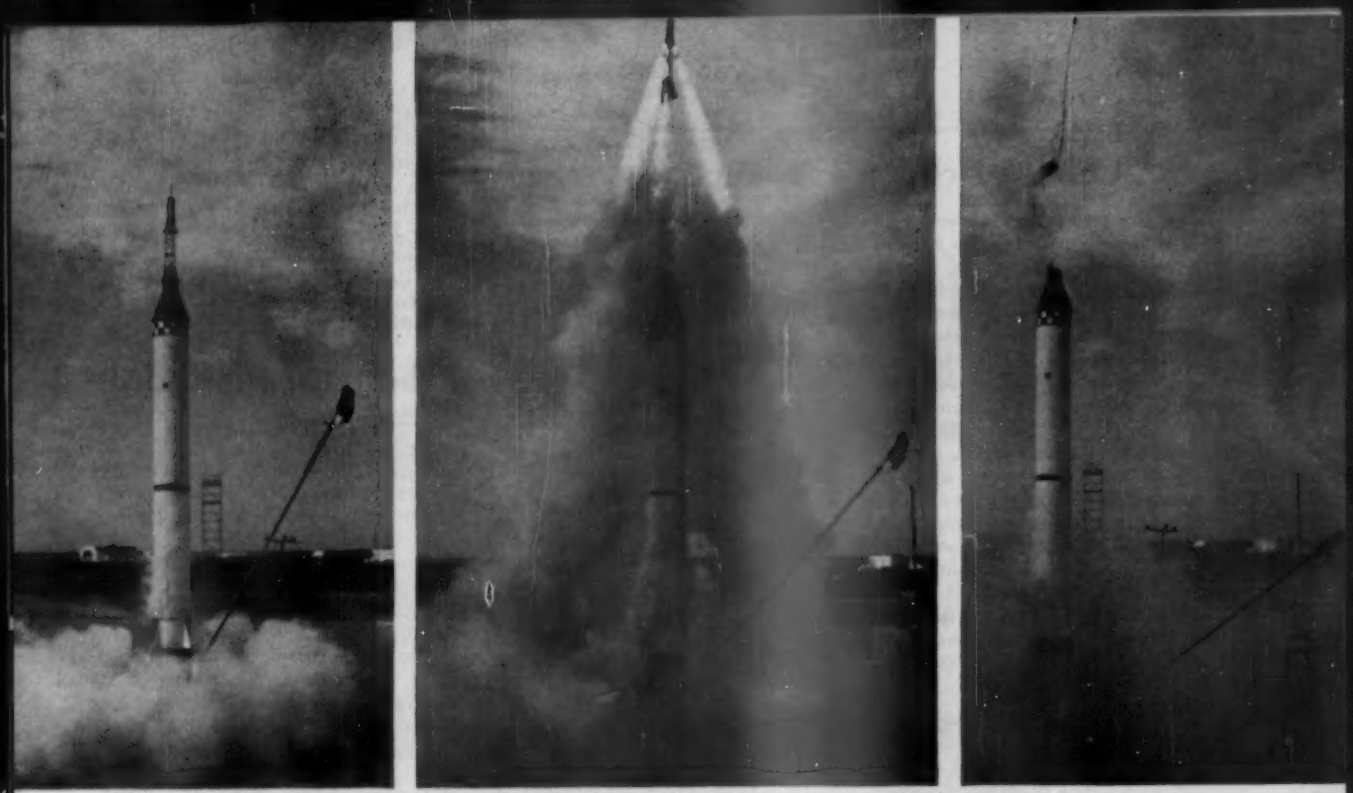
Sequence malfunction has not occurred in more than 50 launches of tactical and research vehicles based on the Redstone booster, Kuettner said. Possible explanation for the MR-1 incident is that relays for the MR program are much more sensitive, and the cutoff switch picked up a voltage which would have been resisted in standard Redstone switches.

Some of the discouragement in the Mercury group from the failure was cushioned when its cause was isolated quickly and found easy to fix. Capsule system performance also was encouraging.

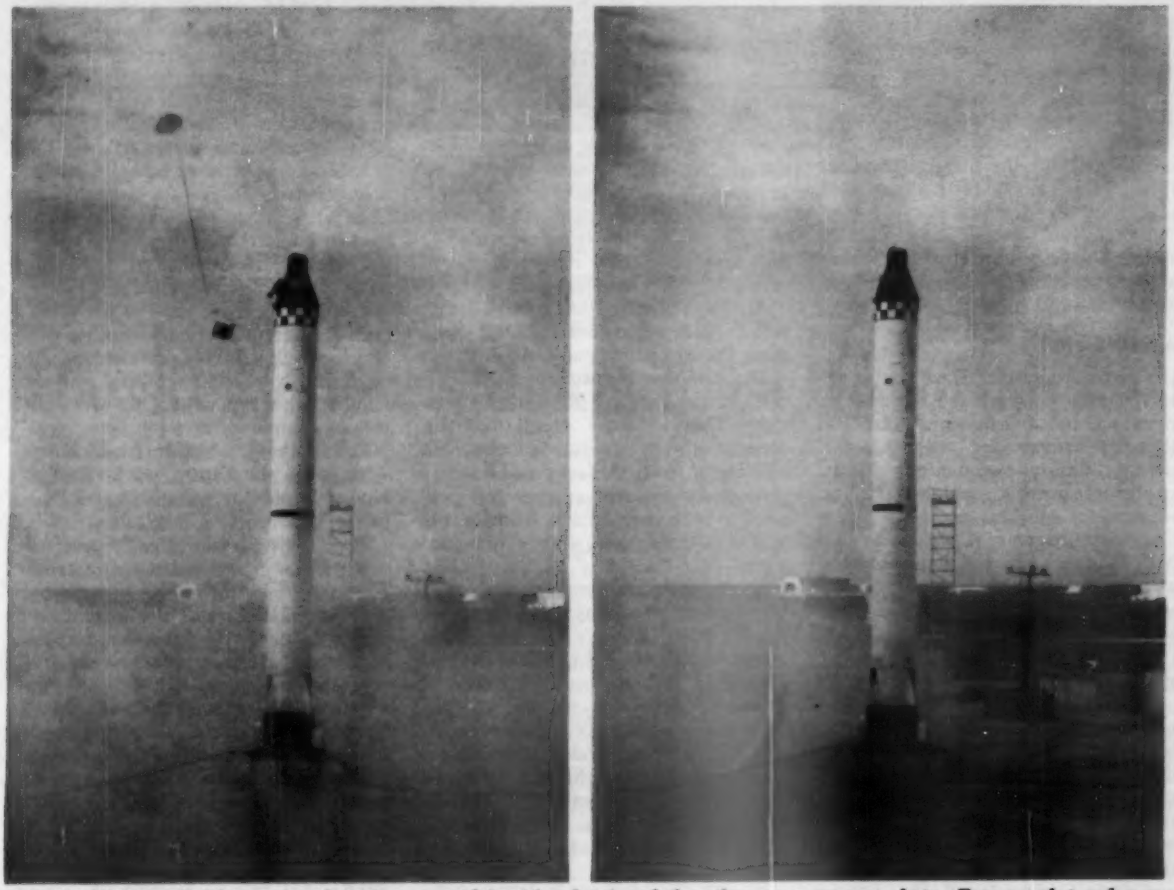
Capsule Sequence

Gilruth said this sequence took place when the engine cutoff signal was given:

- **Tower clamp ring** was separated by explosive bolts.
- **Escape rocket fired** simultaneously with tower separation and carried the 16-ft. rocket pylon 1,500 ft. west of the pad, where it buried itself in the sand. Rocket burned one second and lifted the tower system to an altitude of more than 10,000 ft.
- **Recovery system** was armed by putting capsule power across squib circuitry. In a normal mission, the circuit is closed at 42,000-ft. altitude. Because the capsule was at sea level pressure, the barometric switches were closed and the drogue parachute was fired by its mortar. The drogue chute was lifted



ground switch, tower clamp ring was released by explosive bolts and escape rocket fired, carrying the drogue chute leader with it.



DROGUE CHUTE pulled loose main chute (near ground in right photo) and then the reserve recovery chute. Escape rocket and parachute system will be replaced in this capsule and it will be used again for a second attempt to launch the first Redstone-Mercury flight.

Chimps Delivered for Mercury

Cape Canaveral—Four chimpanzees have been delivered here in preparation for the first life-carrying launch of a Mercury capsule. Recent failure of the Mercury-Redstone vehicle (AW Nov. 28, p. 28), however, will undoubtedly delay the first suborbital flight of an animal until late January or early February.

One group of four animals—three males and one female—arrived here two weeks ago; a second group of four is scheduled to be shipped in about three weeks. Each of the four chimpanzees presently here is being kept in a separate cage to prevent a cold or any illness from spreading to the others. Apes are two to three years old, weigh about 60 lb., are approximately 50 in. tall and have been trained at the USAF Aero Medical Laboratory, Holloman AFB.

The chimpanzees will undergo further training and testing in the Mercury hangar at the Cape, making two-hour simulated space flights in production-line Mercury capsules within a special altitude chamber. Tests will be run at a simulated altitude of 120,000 ft. with internal capsule pressure of 5 psi. Animals will be called upon to perform standard reflex-conditioned tasks during the practice flights, as they will in actual suborbital and orbital flights.

Objective of these simulated flights will be the proper functioning of the ecological (life support) systems developed for Mercury. Major biomedical interests will be the EKGs, respiratory cycles and temperatures of the animals while under test. Capsule performance will also be evaluated. Each chimpanzee has his own specially-molded glass-fiber couch and his own nylon-web restraint suit.

to the limit of its riser, and it pulled the main parachute out. Reserve chute is actuated by a force sensor, and when the sensor did not pick up the opening load of the main parachute, the reserve chute also deployed. Hydrogen peroxide fuel for attitude jets was dumped from its chambers.

With the hot booster on the pad, a potentially dangerous situation was compounded by the wind hazard of the two 63-ft. parachutes hanging from the top of the capsule. Because high winds were not forecast, it was decided to clear the area until the Redstone's batteries ran down and liquid oxygen evaporated and vented.

Cutoff Signal

When the capsule received the signal to perform as it did, it also received a cutoff signal, which turns off internal telemetry and radio beacons, because the capsule sequence was being run before booster separation. Thus, no telemetry data was received.

Associate Mercury Director Walter C. Williams said that if there had been an astronaut in the capsule, a long-boom cherry picker would have been used to rescue him.

Posigrade rockets, used in a normal mission to carry the capsule away from the booster after burnout, did not fire, and the booster-capsule adapter ring did not part because a force sensor which closes the switch operates at a 0.2g force. Posigrade rockets were armed when the tower blew, but the retrorockets ignited to take the capsule out of orbit—were not armed because this doesn't occur until the booster and capsule separate.

MR-1 capsule actually began a sequence which should have been initiated 141 sec. after liftoff when the MR vehicle was to have reached a 34 mi. altitude.

Renegotiation Record Subpoena Case Decided

Washington—Boeing Airplane Co. won one significant point last week, and lost another, in its two-year fight with the Renegotiation Board on the issue of subpoena of the Board's documents in connection with its $9.8 million excessive profits case for 1952.

An order directed by U. S. District Court Judge Alexander Holtzoff made these two key provisions:

- **The company is entitled** to the "performance reports" of the military services. These lengthy reports contain observations by military procurement officials, as well as facts, on Boeing's production performance and were considered by Renegotiation Board in its profits determination against the company.
- **Boeing is barred** from obtaining internal communications of the Board on the basis of executive privilege. This would include all staff memoranda making comments and recommendations on the case.

The Boeing 1952 excessive profits case will be resumed shortly before the U. S. Tax Court in Seattle, now that the side issue of documents subpoena has been determined. The case was recessed in 1958 pending litigation of this issue.

In addition to the $9.8 million excessive profits case for 1952, Boeing also is contesting three other Renegotiation Board determinations in the Tax Court: $7.3 million for 1953; $9.7 million for 1954; and $6.5 million for 1955. The total for the four cases is $33.3 million. The 1953-55 cases will follow the decision on the 1952 case. The Board has cleared Boeing of any excessive profits for 1956 and 1957 (AW Nov. 7, p. 81).

Labor Dispute Ended At Saturn Launch Site

Washington—Union jurisdictional disputes continue to plague construction projects at ICBM and space launch bases, although one problem was solved temporarily last week when workmen called off a strike at the Atlantic Missile Range Saturn launch complex.

Unions sent 200 men back to work on the Saturn complex after the Department of Labor agreed to appoint a fact-finding committee to investigate the construction project dispute.

Atlas, Titan and Minuteman jurisdictional problems were discussed last week at the quarterly meeting of the AFL-CIO Building Trades Council, composed of the presidents of 18 construction unions. Major development from the meeting was an agreement to review wartime jurisdictional pacts to see how they can be applied to current problems, and to put this topic high on the agenda for a February meeting in Miami.

Army Corps of Engineers says missile base construction is back on schedule (AW Oct. 31, p. 85), but labor problems continue. Latest stoppage occurred last week at the Walker AFB, N. M., Atlas base in a jurisdictional dispute.

Dispute at AMR arose when members of the International Brotherhood of Electrical Workers protested assignment of Civil Service workers, who are familiar with the system, to wire electronics equipment in a job being completed without blueprints. Electrical workers on the Saturn job walked off Nov. 14, and the Plumbers and Pipefitters Union left a week later.

National Aeronautics and Space Administration requested an injunction Nov. 19 to end the work stoppage, but the National Labor Relations Board did not act on the request when it appeared that an agreement would be reached.

Labor Department announced a temporary agreement Nov. 26, but the unions conditioned their agreement on the appointment of a fact-finding committee to investigate the situation. Labor Department appointed the committee, composed of representatives of the two unions, Labor Department, NASA and Defense Department, and the group was scheduled to go to Cape Canaveral later last week.

FIRST UNTETHERED hovering flight of the Hawker P.1127 on Nov. 24 was made by veteran pilot A. W. "Bill" Bedford. Plane may be hovering close enough to ground to obtain favorable effect from ground reflection of the discharge from the four lifting jets. Cable at right wingtip is telephone line for communications, indicating that radio equipment was not installed for these first series of hovering flights. Note also that landing gear doors, nose boom and other components adding unnecessary weight have been removed.

Hawker P.1127 Makes First Hovering Test

London—Hawker P. 1127 VTOL fighter prototype made its first untethered hovering flight Nov. 24, just about one month after the initial tethered flight on Oct. 21, and less than 18 months after the first fabrication drawings were issued to the shop.

Powered by a Bristol Siddeley BS. 53 forward-fan engine with a design thrust rating approximating 15,000 lb., the plane was flown by Hawker pilot A. W. Bedford in a demonstration of its unique capability.

First photos of the P. 1127 show the conservative and perhaps necessary approach followed by Hawker and Bristol Siddeley in the hovering trials, which took both airplane and engine aloft for the first time. The plane was stripped of every bit of unnecessary weight, including all fairings and inspection panels, the nose boom mounting flight-test instrumentation and the landing gear doors. Not even a decal or paint marking shows anywhere in the photos.

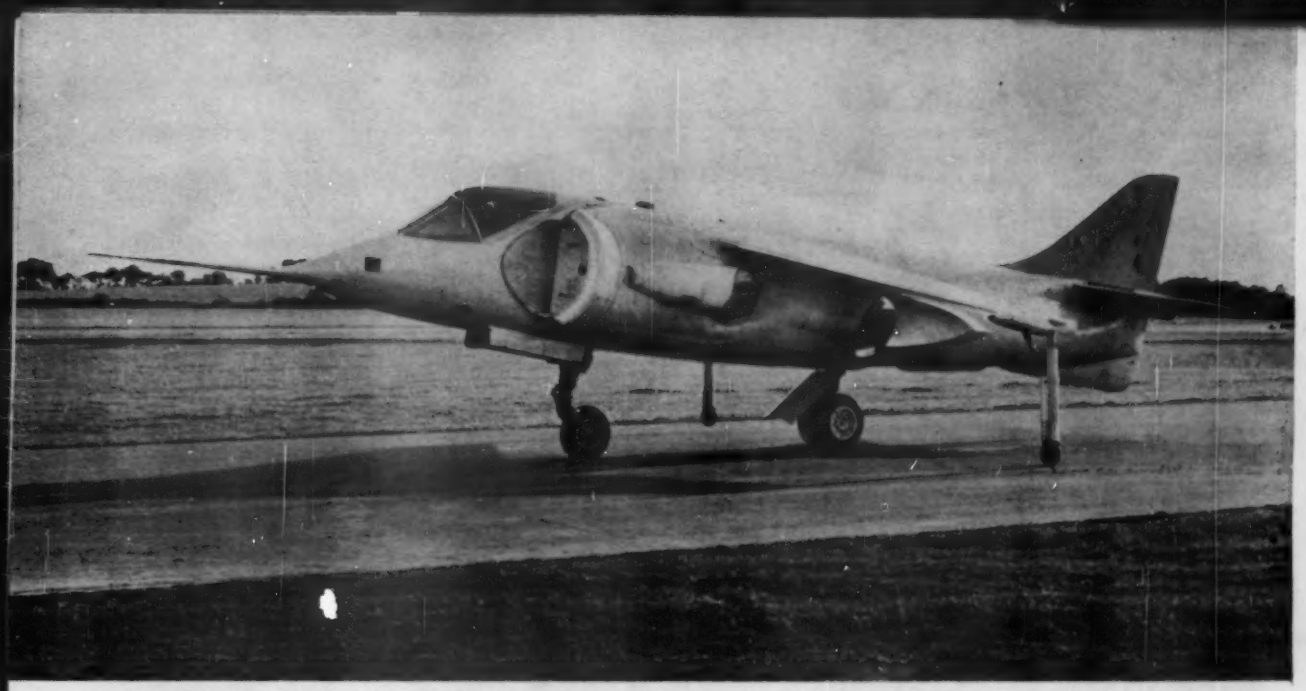
During the flights, Bedford talked to ground crews via telephone line, indicating that even the simplest avionic equipment had not been installed for the hovering trials.

Special bell-mouth lips for the engine air intakes were mounted for these tests, to give the closest approximation to ideal airflow conditions for the engine in order to obtain the last possible ounce of thrust from the powerplant.

A second prototype P. 1127 is nearing completion at the Hawker plant, and is expected to join the first for flight work in a few months. Hawker pilots already have flown the Bell X-14 VTOL aircraft in the U.S. to gain experience with deflected-jet aircraft.

Hawker proposed the P. 1127 and designed it as an operational aircraft around a company-written specification which it hoped would correspond to one later adopted by NATO as GOR-2, a general operational requirement for a VTOL strike fighter. But recent availability of variable-sweep wing data furnished by National Aeronautics and Space Administration scientists to NATO countries (AW Nov. 7, p. 28) has prompted a long look at GOR-2. Observers now predict that the operational requirement will be quietly dropped in favor of a more sophisticated one specifying variable-sweep as one of the design features.

There is a move to order a quantity of Hawker P. 1127 aircraft, perhaps 25 to 50, in order to form a few squadrons for pilot training and initial operating experience with the type. Most ob-



FIRST PHOTO of the Hawker P.1127 VTOL strike fighter prototype shows two of the four swiveling nozzles used to vector the thrust of the plane's single Bristol Siddeley BS.53 forward-fan turbojet. Forward nozzles discharge portion of fan flow; aft nozzles handle engine flow. Inlets have been modified with bell-mouth lips for best flow characteristics.

servers agree this is a desirable approach to produce maximum return on the Hawker initiative and the investment in the program.

The Hawker design as it stands now could not meet an updated requirement, because it represents the state of the art in VTOL of about three years ago.

Hawker has not commented on any of the aircraft detail design features, but some of them can be determined from study of the photographs.

Design Departure

Layout of the P. 1127 is a departure from the family resemblance of the last few fighters designed by Hawker engineering teams under the direction of Sir Sidney Camm. The high wing has large negative dihedral and a nearly straight trailing edge seen in planform. Sweep angle is on the order of 35 deg., and the planform taper ratio is about three.

Wingspan is 24 ft. 4 in. Conventional ailerons are fitted for lateral control during non-hovering flight; it appears that trailing-edge flaps are also fitted for flight operations where more conventional takeoffs and landings are desirable or necessary because of aircraft overload.

Landing gear is a tandem installation, with twin main wheels aft of the airplane's center of gravity and a single nose wheel forward. Retraction of the landing gear is into the fuselage, which leaves the wing structure completely free of cutouts and reduces its structural weight to a minimum. Outrigger gear is fitted to the wingtips and retracts directly aft into a fairing.

Fuselage is 41 ft. 2 in. long over-all. Vertical and horizontal tail surfaces are minimum size; horizontal tail is the slab type.

Fixed ventral fin area is added below the fuselage for additional static directional stability.

Reaction Control System

Most difficult feature to analyze from photos is the reaction control system of the plane. There are obvious control nozzles under the nose and at the intersection of the vertical and horizontal tails. If general design practice is to follow the proven reaction-control system of the Short SC.1 (AW Oct. 17, p. 78), these fore-and-aft nozzles are used for control in the pitch plane. Other openings shaped like reaction-control nozzles are visible on the sides of the fairing for the forward engine exhaust nozzles, and on the wingtip landing-gear fairings. Either of these—if they are nozzles—could be used for roll control.

Yaw control means are not apparent, and may not exist as part of the reaction system. There is a pair of fairings on the underside of the wing, at about mid-span of each panel, which might enclose air lines leading to nozzles pointing aft for yaw control. An alternate scheme would be to swivel the nose and tail pitch nozzles so that lateral components of the vectored control thrust would produce a yawing moment.

Bristol Siddeley BS.53 powerplant is a forward-fan engine which discharges both fan and engine exhaust through four swiveling nozzles, two forward for the fan and two aft for the engine. These nozzles have internal guide vanes to turn the flow through nearly 90 deg. to the plane of the nozzle exit. The nozzles can be swiveled so that all the engine and fan thrust is directed at any angle from a few degrees forward of the vertical to straight aft.

Basis of the engine is the lightweight Orpheus powerplant; the fan stage was adapted from the first three compressor stages of Bristol Siddeley's Olympus turbojet. Engine designers added an extra low-pressure turbine to the basic Orpheus frame in order to drive the fan stage.

Discharge from the fan is split to go partially through the engine and partially around it and out through the forward jet nozzles.

Engine Thrust

Estimated eventual thrust of the engine is 15,000 lb. but the best estimate is that the engine is running well below its design figure, perhaps at 12,000 to 13,000 lb.

The large rotating mass of jet engines produces gyroscopic coupling forces when an airplane is displaced around the yaw or pitch axes, and these forces are of magnitude great enough to pose a tough problem to the designer of the control system in a VTOL vehicle. But in the BS.53, gyroscopic moment of the engine has been reduced to a minimum by driving the fan and the compressor in opposite directions.

The engine has been running on the test stand for the past year; the installation in the Hawker aircraft is its first appearance in a flying vehicle. Development of the engine has been financed by the Mutual Weapons Development Program.

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9168 to 1	1.25	100 oz. in.	0.085 max.	3.140	E179
4056 to 1	2.75	100 oz. in.	0.100 max.	2.980	E215
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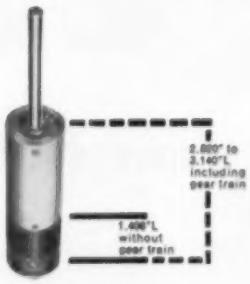

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Senate Space Group Urges Effort To Settle Communications Issue

By Philip J. Klass

Washington—Immediate research effort to resolve the question of possible interference between terrestrial communications services and communications satellites has been recommended in a staff report to the Senate Committee on Aeronautical and Space Sciences.

The report, entitled Policy Planning for Space Telecommunications, also calls for immediate examination of the implications of recent Federal Communications Commission decisions on the availability of radio frequencies necessary for space communications.

In October, FCC denied a petition by the American Telephone & Telegraph Co., and other common carriers, that it set aside an earlier decision to allocate frequencies above 890 mc. for private microwave system users—frequencies which AT&T said were needed for communication satellite service. In the recent decision, FCC denied the request for reconsideration and indicated that it believed that both types of service could co-exist without interference problems.

Senate Ratification

The most immediate space telecommunications issue that will face the 87th Congress next year, the report points out, concerns ratification by the Senate of the multilateral treaty with 101 nations, including the Soviet Union, based on frequency allocation agreements reached at the recent International Telecommunication Union conference in Geneva. These include the first limited-frequency allocations for earth-to-space radio transmissions.

The treaty, submitted by the President to the Senate on June 9, will go into effect on May 1, 1961 if ratified by the Senate. The staff report offers no reasons why the treaty should not receive Senate approval.

The staff report does cite these questions, however, which merit consideration and possibly investigation by the Congress:

- **Is the National Aeronautics** and Space Administration program for communication satellites "being pursued with the vigor and emphasis that this form of global communications appears to promise?" Also, is there adequate coordination between NASA and Defense Department on their active communication satellite programs.
- **Have the international** implications of communication satellites, particularly their potential use by the less well developed countries, been examined by the State Department and NASA?
- **Are steps being taken** to solicit cooperation and support of other nations in setting aside wider bands in the radio spectrum for space service? The report points out that at the recent ITU meeting in Geneva, the U. S. was the only country that came prepared with proposals for frequency allocations for space use, and that except for Britain and the USSR there was little interest among the rest of the nations. If additional frequencies are to be made available to the Extraordinary Administrative Radio Conference in 1963, considerable effort must be devoted to convincing other nations that they can benefit from the communications satellites.
- **What is the role of private** enterprise in communications satellites and to what extent should U.S. common carriers be free to enter into cooperative agreements with other nations on space relays? Should common carriers follow the pattern used for long distance radio and submarine cables?
- **What will be the jurisdiction** of various federal agencies in the task of licensing private applicants and assigning frequencies to government applicants for space communication systems? In the past the FCC has had the statutory authority for licensing private applicants while equivalent authority for licensing government/military agencies rests with the Interdepartment Radio Advisory Committee (IRAC), which reports to the Director of the Office of Civil and Defense Mobilization. In the past, these two agencies were free to allocate frequencies within the framework of international agreements. With the advent of communications satellites, two new government agencies enter the picture: the State Department and NASA. The authority and area of responsibility of each of these agencies in the field of satellite communications requires reexamination and possibly redefinition, the report suggests.

Come Prepared

If the U.S. hopes to obtain additional radio frequencies for both space experiments and operational communications satellites, it must come to the 1963 ITU conference armed with technical data on the frequencies that are suitable for space, the bandwidths required and the feasibility of channel sharing, the report warns. To date, the U. S. has more conflicting opinions than actual data.

The Soviet bloc may not support the allocation of additional frequencies because its control over so large a land mass does not require international agreement to the extent needed by the U. S. and smaller countries, the report points out.

The U. S. will need to exercise utmost skill in negotiation and advanced preparation to convince other ITU member nations of the benefits of space systems.

The report points out that many of the new African nations can not communicate directly with each other, but must use radio or cable circuits which go through London or other European cities.

A single communication satellite over Africa offers attractive possibilities for providing a link between all African nations.

Nuclear Facility Design Award Due

Washington—Contract to design National Nuclear Rocket Development Facility will be awarded soon, and leading contenders are Aetron Division of Aerojet-General Corp., a Bechtel Engineering-Rocketdyne team and a Parsons-Thiokol Chemical Corp. team.

Award of the four-month National Aeronautics and Space Administration contract follows a bidders conference Oct. 7 at the atomic test site, Jackass Flats, Nev. Representatives of 31 firms attended the conference, and 12 submitted proposals for the design contract, which will be worth several hundred thousand dollars.

Definition of facility requirements called for by the contract includes cost analysis, and early estimates put the construction and instrumentation cost between $35-$50 million.

Site consideration also is a study requirement, with Jackass Flats considered the most likely site. Harold B. Finger, manager of the Atomic Energy Commission-NASA Nuclear Propulsion Office, recently told a technical group that the national test facility will make maximum use of existing test facilities at the AEC's Nevada site.

Design study will be the basis for a facility master plan, which will be prepared by Finger's office.

Installation will be NASA's, with AEC responsible for reactors. No decision has been made on which NASA center will manage the facility, but it is expected that scientists will be drawn from both Lewis Research Center and Marshall Space Flight Center for the new test facility.

Future Chemical Rockets May Cut Costs

By Michael Yaffee

Boston—Several novel chemical rocket propulsion programs now under study may cut orbital payload transportation costs to less than $1 per pound within five years and could significantly alter the roles of current aerospace systems producers.

First public disclosures of most of these systems were made here last week at the seventh annual science and engineering symposium, sponsored by the USAF Air Research and Development Command. Among the more significant developments mentioned were the following:

- **Mushroom-shaped rocket engine** which could obtain maximum exhaust expansion with minimum nozzle length and weight.
- **Tri-propellant system** in which some fuel, probably a metal, would react with liquid oxygen to heat (but not burn with) liquid hydrogen.
- **One-hundred-per-cent,** volumetrically-loaded, multigrain solid propellant rocket that would be at least 37% shorter and 24% lighter than the Minuteman.

Within a decade, this country's space program will require an orbital payload capability of 100,000 to 300,000 lb., according to Dr. Krafft A. Ehricke of Convair Division of General Dynamics. At the present time, putting even a small payload into a 200-300 naut. mi. earth orbit requires the sacrifice of either a Thor or Atlas booster and, subsequently, costs well over $1,000 per pound of payload put into orbit. Even with the Saturn, it is anticipated that orbit costs will still be approximately $500 per pound.

Recovery Requisite

To achieve truly economical orbital transportation—$1 per pound or less—of large payloads of from 30,000 to 50,000 lb., Dr. Ehricke said, it will be necessary to develop a one-stage booster or carrier rocket that can be recovered. While a nuclear propulsion system could do the job, radiation problems—especially the danger associated with having a hot reactor enter the earth's atmosphere—argue against the nuclear rocket for this particular mission. Moreover, he said, it now appears that this job can be done by advanced chemical rocket engines now being investigated, mostly under contracts calling for feasibility studies.

One of these chemical systems is essentially a large liquid hydrogen and liquid oxygen Centaur engine. Probably the quickest and easiest to develop, it is also the most marginal in performance of the advanced systems and may require a second stage in order to place a 30,000-50,000-lb. payload in a 200-300-mi. orbit.

Another approach and one promising greater performance is the tri-propellant chemical system. At the present time, this is envisioned as basically a cryogenic system using three different liquids or slurries. Most likely propellant candidates for this system are liquid oxygen, liquid hydrogen and some fuel, probably a metal slurry, that has a greater affinity for oxygen than has hydrogen.

Purpose of a system such as this is to increase specific impulse—and thereby performance—by increasing combustion temperature and at the same time maintaining a low-molecular-weight exhaust. A metal burned with liquid oxygen would provide a higher combustion temperature than hydrogen and oxygen; and this heat would be picked up by the hydrogen which would be ejected as part of the combustion products to provide the desired low-molecular-weight exhaust. To date most of the work in this area is still analytical in nature and is being carried out in-house by the Air Force, according to C. William Schnare of the Air Force Flight Test Center.

What may be the most unusual and at the same time most promising approach of all to improved chemical rocket system performance is the work now going on in industry under Air Force contract on new rocket designs. In his report on trends in rocket propulsion, Schnare said that new configurations in rocket design offer more compactness and simplicity and could double the available thrust-to-weight ratio. The next few years, he said, will see almost a complete revolution in the chemical rocket industry.

Mushroom Configurations

In five years, it is possible that rockets won't look like rockets at all, Schnare said. They may look like inverted mushrooms with the nozzle virtually buried in the cap. Schnare would not go into details of any projected design but did mention some possible changes that might be made including shortening of nozzles, use of ablation or film cooling in place of more complex and expensive regenerative cooling, elimination of turbopumps, changes in combustion chamber design and amalgamation of combustion chamber, nozzle, pressurization system, tankage and other components into an integral vehicle or stage.

This amalgamation or integration of components is expected to have a significant ancillary effect on the role of aerospace contractors. It means, Schnare said, that in the future the complete stage will be purchased from the engine manufacturer. As a result, more and more airframe companies will become system managers, getting assemblies from contractors and simply putting them together as Boeing is essentially now doing on the Minuteman.

The object of the design changes is to reduce the inert component or burnout weight of the rocket, about one-third of which is accounted for by the nozzle. By shortening the nozzle, developing new tankage materials and new propellant feed techniques, using new cooling techniques and so on, Schnare said, it may be possible to decrease the inert parts weight by 40% or more and double payload or range.

Among those companies currently believed to be carrying out government-contracted studies in the design area are General Electric, Rocketdyne and Thiokol. Some breadboard configurations have been developed and tested. Schnare made it clear that plug nozzles were not part of the work in this area he was discussing. Plug nozzles, he feels, don't offer as much gain in per-

New Soviet Satellite

Washington—Soviet Russia launched its third five-ton spacecraft into orbit around the earth last week. The satellite carried two dogs and a variety of plant and animal life. Russia was expected to try to recover the portion of the satellite housing the live specimens.

The satellite, called Sputnik VI or Spacecraft III, apparently was launched Dec. 1 at an inclination of 65 deg. to the equator into an orbit with a 117-mi. perigee and a 165-mi. apogee. Orbital period was 88.6 min., according to Russian news sources.

Soviets gave the weight of the satellite as 10,060 lb., said it is transmitting on 19.995 mc. and that biomedical information was being returned by telemetry and radio-television signals.

Last May 15, Russia launched the first of the 5-ton vehicles which it calls "spacecraft." This vehicle, known as Sputnik IV or Spacecraft I, carried a dummy astronaut. An attempt to recover the cabin portion failed, apparently because the vehicle was oriented the wrong way then the retrorocket fired. On Aug. 19, a second spacecraft carrying two dogs and other plant and animal life was launched. Russia claimed to have recovered the life-supporting capsule Aug. 20.

First Photo of Navy-Martin Bullpup B

More powerful advanced version of the Navy's Bullpup air-to-surface missile has come off the Martin Co.'s assembly lines at Orlando, Fla. Navy and Martin spokesmen said the Bullpup B is in advanced test stages but that details of the new configuration cannot be publicized. Martin was awarded a $2,561,000 Navy contract for Bullpup B in April. Retouched photo shows actual Bullpup B.

formance as some of the other designs.

One of the new nozzle designs that is believed to be receiving serious consideration and one that would lend itself to the mushroom configuration is the concentric or skirted nozzle. This consists of a fairly conventional, small liquid-cooled nozzle inside a large uncooled outer nozzle. During the initial stages of flight in the atmosphere, the small nozzle would be the only one affecting the expansion of the exhaust. Later, in space, as the exhaust expanded, it would flow out and along the walls of the large nozzle. In effect, this would be a self-adaptive expansion nozzle that would ensure maximum performance from sea level to space at a minimum penalty in length and weight.

Somewhat akin to this is another new concept—the reverse-flow rocket engine, in which the small inner nozzle is reversed, exhausting in the direction of flight into the larger nozzle, which then reverses the exhaust flow in an effort to provide an increased expansion ratio without an accompanying increase in nozzle length.

With developments progressing as they are, Schnare said, it is also possible to predict an ICBM rocket that is lighter in weight than the Polaris. More specific information on this was available from three Air Force Flight Test Center representatives, 1st Lt. E. R. Flemig, Willard S. Bacon and Wilbur C. Andrepont, who reported on ultra-high-performance solid-propellant motors.

In this work, the goal has been to increase the performance of solid-propellant missiles through new grain designs rather than through the development of new propellants or hardware. Although no specific solid propellant missile is mentioned, it is believed that this work is aimed primarily at the Midget Man small ICBM concept. At the present time, the Air Force has let two contracts to industry for a motor loaded with solid propellant consisting of two or three different propellant grains. This motor reportedly burns out simultaneously at all points on the case wall, without the need for insulation, and produces constant mass flow. It is believed that this can be achieved by using a propellant in the center that has a faster burning rate than the propellant surrounding it. The motor would ignite as an end burner but then, as the center burned down more quickly than the surrounding propellant, the motor in effect would develop a core and burn from the inside out as well.

Another outgrowth of this work has been the design of a multi-stage vehicle that was considerable more volume available for propellant loading than in conventional designs, through what is believed to be a "headless" rocket motor.

The Air Force combined these two concepts in a design study of a three-stage solid propellant ICBM that was named the Muroc missile. In this study, the Muroc missile was compared with another three-stage ICBM using conventional solid-propellant stages. The study showed that the Muroc missile would be 24% lighter and 37% shorter than the other, a result that "has great significance" in terms of ease of transport—and current thinking regards mobility as a prime factor in survival capability.

News Digest

North American Aviation reported sales of $946,162,496 and profits of $23,394,548 or $2.87 a share for its fiscal year ended Sept. 30, down from 1959 sales of $1,044,899,580 and earnings of $30,726,134 or $3.80 a share.

McDonnell Aircraft Corp. and Handley Page, Ltd., have discussed possible joint operations, but merger or sale of Handley Page does not appear to be in the picture. J. H. S. Green, Handley Page secretary, visited McDonnell for a day recently, but no further meetings have taken place.

Grumman Aircraft Engineering Corp. received a $70.1 million follow-on production contract for the Navy A2F-1 Intruder low-level attack aircraft.

Second Atlas E flight from Cape Canaveral, Fla., failed last week when the sustainer engine shut down shortly after the booster engine section separated. Instrumentation added after the first E-series shot has narrowed the trouble area enough so that engineers believe they can pinpoint the specific cause of both failures.

Brazil's National Economic Development Bank has appointed a task force to establish an airframe industry to meet a pressing need, particularly for light aircraft, in the development of the country's interior.

Soviet Record Claim

Moscow—Soviet Russia claimed the absolute and 100 km. world aircraft speed records last week and said it will submit them to the Federation Aeronautique Internationale for certification. A delta-wing E-66 piloted by Konstantin Kokkinaki flew 1,334.95 mph. over a 100-km. closed course at 44,500 ft. and reached almost 1,800 mph. in some stretches, the news agency Tass said. The E-66 is believed to be the Sukhoi-15 Fishpot fighter, powered by a 22,000-lb. thrust axial flow turbojet.

The claim puzzled U. S. observers because a Navy-McDonnell F4H-1 flew at 1,390.1 mph. over a 100-km. course last Sept. 25 and at 1,216.78 mph. over a 500-km. course 20 days earlier. The Navy's 100-km. figure is higher than the Russian claim and preliminary notices of both Navy claims were filed immediately with FAI, giving them a time precedence over Russia's flight. The only previous record referred to by the Russian announcement was the 1,298.7 mph. record set last summer by Soviet pilot Boris Adrianov in a T-405, which is believed to be the MiG-21 Faceplate fighter.

CAB Explains Its Rate-Making Techniques

Board outlines approaches to help weaker trunks; they include subsidy, higher fares, route changes.

By L. L. Doty

Washington—Far-reaching four-point program that establishes new precedents for bolstering earnings of weak domestic trunklines has been proclaimed by the Civil Aeronautics Board in its final decision in the General Passenger Fare Investigation.

For the first time since all domestic trunklines became subsidy-free, the Board formally suggested it will again resort to subsidy for less profitable trunklines as part of its new program—where the interests of commerce, postal service and the national defense are served. It also stated that readjustment of competitive routes may be a solution to the poor earnings character of some carriers.

Repeatedly throughout the 77-page document, the Board referred to the unstable condition of the industry resulting from "financial and other problems" created by the transition to jet equipment. It said it could not establish rate-making standards until the industry has reached a more stable period.

Difficult Problems

In its decision, the Board admitted that "the problem of accommodating the requirements of the weak and strong carriers . . . is one of the most difficult to be found in regulation." It added that general fare increases are not necessarily the panacea" that will solve this problem, and it then evolved its new policy by suggesting these four tools for dealing with less profitable carriers:

- **Over-all examination** of the general passenger fare structure which might result in bringing the costs and revenues of individual carriers into closer alignment. An analytical study of passenger fares with the view of overhauling the tariff structure was excluded from the issues considered in the General Passenger Fare Investigation, but such survey now appears imminent.
- **Carriers whose needs** are not met by fare level adjustments can seek higher fares. The Board admitted, however, that competition would probably prevent airlines from charging fares higher than the established level except on monopoly routes.
- **Realignment of routes** to produce a more balanced competitive route structure.
- **Subsidy payments** where the Board finds that such compensation is required in the interests of commerce, postal service and national defense.

G. Joseph Minetti filed a concurring and dissenting opinion. John S. Bragdon, who has been a Board member for only three months, did not participate in the case.

The formal decision, which amplifies the press release announcement of last May (AW May 9, p. 46), declines to set a fare level for the trunkline industry although it reinforces the original decision to allow a 10.5% return on investment. Thus, the industry is left in another quandary as to whether the final decision is an open invitation to request a second rate boost this year as a means of breaking the current tight squeeze on profits (AW Nov. 21, p. 35).

Trunklines flooded the CAB with a torrent of petitions for rate hikes ranging from $1 per ticket to 10% across-the-board over previous fares immediately following the press release announcement (AW May 30, p. 39). The Board suspended the tariffs but subsequently granted a fare increase that approximated 6% (AW June 27, p. 41).

Most trunklines feel that the way has been opened to ask for rate increases on certain routes as a first step toward inflating revenues and bringing the rate of return to 10.5%, a weighted industry average. Under the Board's plan, the Big Four trunklines would be allowed to earn 10.25%, the smaller eight carriers would earn 11.125%.

The Board decision does not provide a guarantee that the industry should promptly earn a weighted average of 10.5% rate of return, since the standard is based on long-term activity and the Board wants to clearly determine whether the industry's current fiscal doldrums are temporary or long-range. Profits in 1959 for the 12 trunklines were 7%, but they had dropped to 4.6% by June, 1960. The figure undoubtedly will drop substantially when profits for the first three quarters are fully adjusted.

Marketing Inhibitions

Chances are strong that most carriers will be reluctant to ask for a fare increase at this time, despite a leveling-off of revenue growth patterns. Most carriers are now in the grip of a tight competitive race for traffic and are not likely to run the risk of the very obvious handicap of over-pricing, even on high density traffic routes.

Some observers are interpreting the Board's decision to imply that it will entertain petitions for fare increases and that the competitive factor will iron out rate differences sufficiently to allow fares to seek a natural economic level. Industry has traditionally held that it should be granted the prerogative to decide on a fare level within a range differential area fixed by the CAB. As a result, the interpretation may be wishful thinking rather than a hard analysis of the facts.

In the decision, the Board gives no indication that it is ready to allow the trunk carriers any such freedom in setting a rate level other than to say that ". . . carriers whose needs are not met by general fare level adjustments can seek higher fares . . ." On the subject of cost and load factor standards, it declares that ". . . it is clearly not the function of the Board to assume the role of management and substitute its judgment for that of carrier management with respect to matters which are the prerogative of management." It admitted it was precluded from regulating fares on the basis of policies divorced from factual findings, but added:

"On the other hand, the Board is under statutory injunction in determining rates to consider such factors as "the need in the public interest of adequate and efficient transportation of persons and property by air carriers at the lowest cost consistent with the furnishing of such services; the promotion of ade-

Boeing 727 Production

Boeing Airplane Co. is expected to announce this week that it will build the Boeing 727 triple-turbofan transport based on orders from Eastern and United Air Lines (AW Nov. 28, p. 45). Boeing probably will use an appearance tomorrow before the New York Society of Security Analysts as a forum. Powerplants will be Pratt & Whitney JT8Ds.

quate, economical, and efficient service by air carriers at reasonable cost; and the need of each carrier for revenue sufficient to enable such air carrier, under honest, economical and efficient management, to provide adequate and efficient air carrier service."

In his dissent, G. Joseph Minetti, who recently has been frequently mentioned as a leading candidate for the Board chairmanship, expressed fears that increased fares will depress traffic but emphasized that no two observers appear to agree on the exact fare level where this will occur. On this point, Minetti said:

". . . If the present cost levels prove to be permanent, rather than temporary bulges, the currently high fare levels must be maintained whatever the effect may be on the movement of traffic and on utilization of the industry's current and anticipated huge amount of capacity. If costs, however, prove to have been only temporarily inflated, and assuming that current fare levels adversely affect traffic growth, we will be able to take action to reduce fares to a point consistent with representative cost levels and with resumed traffic growth in the degree necessary to profitable equipment utilization."

Minetti said he would grant an 8.75% rate of return for the Big Four and 9.6% for intermediate carriers as "reasonable and ample."

Here are the main points brought out in the Board's formal decision on tariffs and rates of return:

• **Standards for passenger fare** regulation should be based on the profit element, rate base, depreciation and taxes. However, the Board declined to fix a rate level because forecasts of future operations by the airlines were found to be insufficiently reliable for such purposes.

• **Industry profit element** should be regulated by the conventional test of rate of return on investment rather than by the operating ratio or its complement—the return margin. The Board found that the rate of return, which keys return to capital investment, assures earnings sufficient to compensate for the capital invested in the business. It added that operating ratio, which relates return to revenues, gives no clue to the return required to pay capital costs and attract new capital.

• **Rate of return** of 10.25% to be allowed the Big Four carriers is derived from the averaging of 4.5% cost of debt and 16% cost of equity to a capital structure consisting of 50% debt and 50% equity. Rate of the intermediate eight airlines is based on the averaging of 5.5% cost of debt and 18% cost of equity to a capital structure consisting of 55% debt and 45% equity. Debt costs agree with those recommended by Examiner Ralph L. Wiser, but the Board's cost of equity rate differs slightly from Wiser's rate.

• **Rate base** to be used for the fare regulation should consist of net working capital, net operating property and equipment after deductions for depreciation and overhaul reserves, and other used and useful assets including equipment purchase deposits.

• **Depreciation charges** on flight equipment should be based on a seven-year life and 15% residual value for piston-powered aircraft and airframes. Depreciation charges for turbine-powered aircraft should be based on a 10-year life and 15% residual value for airframes and a five-year life and 15% residual value for turbine engines. The Board said 5% of airframe costs should be included in the residual value as a built-in overhaul allowance. On this point, the Board rejected the Bureau Counsel's proposal that a flat depreciation charge of 2.45 cents per available ton mile be used, based on the over-all industry experience for the 12-year period 1946-1957. It also disapproved the position taken by some carriers that the Board was required to accept industry's depreciation rates and figures unless they are shown to represent dishonest, inefficient or uneconomical management.

• **Federal income tax expense** recognized for rate-making purposes should be based on normal tax paid under straight-line depreciation rather than under permissible liberalized depreciation privileges.

• **Board rejected all forecasts** of future operations by the carriers and the Bureau Counsel on grounds that the economic recession of 1957-1958, the series of strikes grounding several airlines in 1958 and 1959 and the transition to turbine-powered equipment do not provide a normal base for projecting future traffic trends. The Board found that the industry's forecast of 27.5 billion passenger miles for 1958 and 31 billion for 1959 fell far short of actual results of 24.6 billion in 1958 and 28.3 billion in 1959.

• **Board refused to accept** proposed standards concerning load factors and cash costs because of the unstable nature of the industry at the present time.

• **In setting fare levels** in future cases, the Board will regulate fares to produce a reasonable return over an extended period of time. It said that the decision when to permit fare adjustments "cannot be relegated for solution to any mechanical device, but can be solved only on a case-to-case basis, applying informed judgment to the task of balancing the relevant facts."

• **In determining fare adjustments,** the Board will give consideration to the extent to which the fare level meets the costs of the Big Four and the intermediate eight carriers. Fare adjustments normally will be based on the results for the industry as a whole, and not for the smaller trunks or the financially weakest carrier.

Imminent Certification Seen For BEA Vanguards; TCA's Delayed

London—Vickers is expecting full passenger-carrying certification for BEA Vanguard Type 951 from the Air Registration Board soon. It expects to be able to offer the engines at delivery with an overhaul life of between 400-500 hr., AVIATION WEEK learned.

Certification for the Vanguard Type 592 for TCA is not expected until later in December due to equipment problems with the Collins autopilot.

BEA has already planned to use the Vanguard on an ad hoc basis on the London-Paris run over the Christmas period. But fully scheduled operations are not due to start until Mar. 1 when the aircraft will be used on British internal intercity route network. By this date overhaul life may be higher.

Vanguard G-APED fitted with the fully modified production Tyne engines completed the 200-hr. engine "assurance" problem on Oct. 31. Flying a simulated airline pattern involving three or four trips per day, six days a week, the aircraft completed the 200 hr. in 25.

Two of the engines were stripped immediately after the program for detailed examination by Rolls-Royce and the Air Registration Board. The other two were transferred to Vanguard G-APEE and subsequently passed a similar examination after 250 hr.

It is understood that both Rolls-Royce and the ARB were sufficiently impressed with the condition of the engines to start the engine with the same overhaul life at time of delivery as was authorized for the Dart. Since its first flight 22 months ago, the Vanguard has logged 1,900 hr. in the certification program and the 12 aircraft now flying have made over 1,100 flights.

The program was delayed for six months by a metallurgical fault in the compressor disks (AW June 6, p. 43).

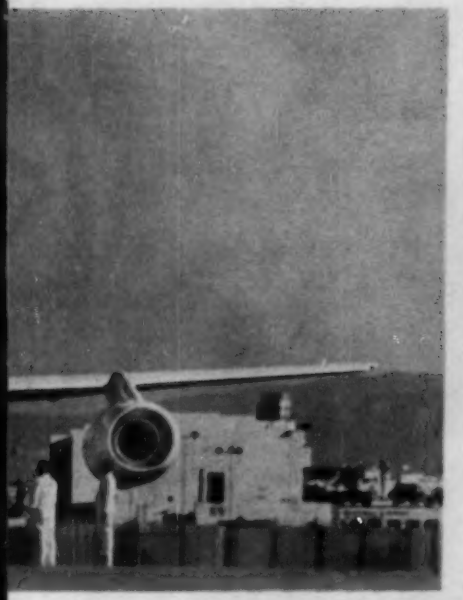
Autopilot clearance for the TCA Type 952 Vanguard is being undertaken on Vanguard G-AOYW, the first development aircraft to fly, so that this requirement will not affect aircraft deliveries. This aircraft has completed nearly 450 hr. during 300 flights.

Apart from the autopilot, the Collins flight system has been cleared with all associated radio gear and the necessary flying for certification up to ISA plus 15C has been completed.

FIRST CONVAIR Model 990 jet transport is rolled out of the plant at Lindbergh Field, San Diego, Calif. General Electric CJ805-23 aft fan

Convair Rolls Out First Model 990 Jet;

CONVAIR 990 wing has a leading edge sweep of 39 deg. and wing includes four speed capsules to reduce drag.



engine pods are 6 ft. in diameter.

Testing Begins

By Russell Hawkes

San Diego, Calif.—First Convair 990 jet transport, formerly designated the Convair 600, has been rolled out and is scheduled to make its first flight in January.

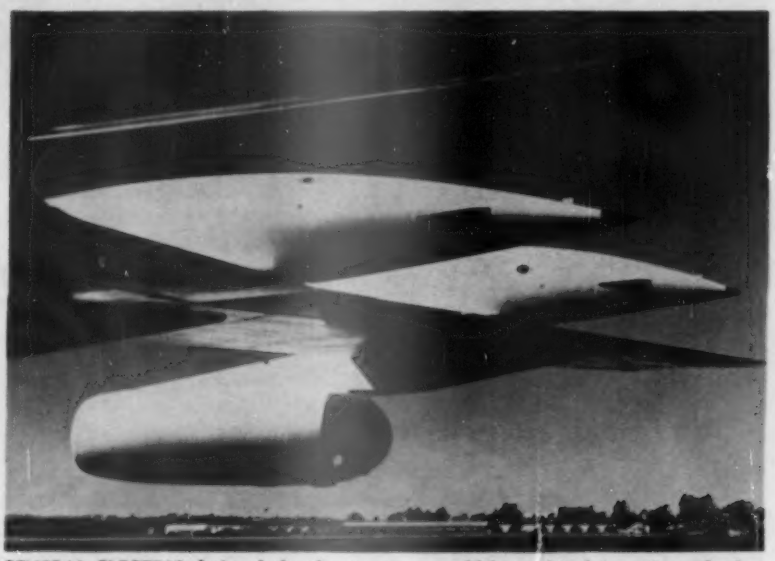
Ground testing of the number one aircraft already has begun in a Convair test hangar at Lindbergh Field here. Three other airplanes will join it in the Federal Aviation Agency airworthiness certification test program and another will be used for extensive stress testing.

The 990 is to be in service with airlines in 1961. It will be built in two versions, the basic 990 for domestic service and the Coronado 990 for intercontinental routes. Convair has announced a total of 37 firm orders for the two versions. American Airlines has ordered 25 of the domestic version and Coronados have been ordered by Swissair (7), Scandinavian Airlines System (2), and Real Aerovias Nacional of Brazil (3). Trans World Airlines is expected to get six in addition to these orders (AW Nov. 28, p. 39).

The 990 has a maximum cruising speed of 640 mph., which is 25 mph. faster than the earlier Model 880. Convair intends to have it certificated for 640 mph. cruise speed. Most of the speed improvement is due to the installation of General Electric CJ805-23 turbofan engines, each rated at 16,100-lb. thrust, and to a radically new high-speed wing design.

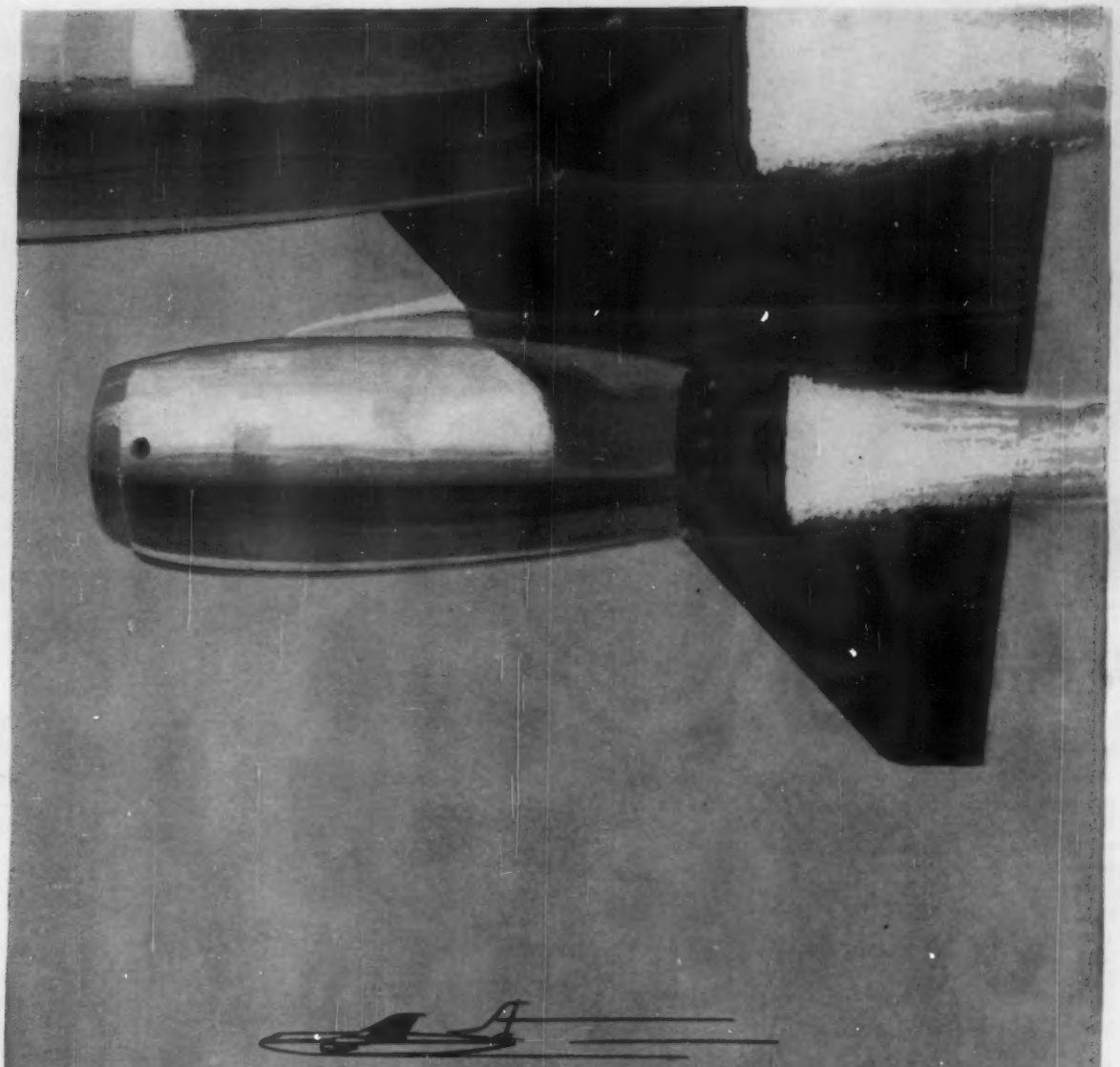
The most obvious innovation in the new wing design is addition of four

CAPSULES are flat-bottomed to avoid interference with lower wing surface flow. Flattening the bottom also makes possible a longer flap span.



GENERAL ELECTRIC designed the thrust reversers, which are faired into the pod when retracted. Double slotted Fowler flaps extend beneath the capsules.

MODEL 990 can carry up to 121 passengers in tourist configuration. Cabin air supercharger inlets are visible just below the wing root leading edge.



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CONVAIR 990 TRANSPORT is 139 ft. 5 in. long and 39 ft. 6 in. high. Wingspan is 120 ft. Note clamshell thrust reverser.

streamlined afterbodies on the upper surface of the wing extending aft of the trailing edges. The afterbodies, first demonstrated experimentally by scientists of the National Aeronautics and Space Administration, are called speed capsules by Convair engineers (AW Sept. 8, 1958, p. 50). The capsule tails, extending aft of the wing trailing edges, have flat lower surfaces to minimize their influence on airflow along the lower surface of the wing. This arrangement also allows trailing edge control surfaces to extend beneath the capsules.

The inboard capsules are 21.5 ft. long and the outboard capsules are 24 ft. long. Maximum thickness of the large capsules is about 2 ft.

Sweepback of the 990 wing is 39 deg. at the leading edge; Convair officials call it the thinnest wing being used on a jet transport. Leading edge slats which are extended at the same time as the trailing edge flaps postpone airflow separation to higher angles of attack, enabling pilots to take off and land in nose-high attitudes that shorten takeoff and landing distance requirements.

Wingtip trailing edges are slightly reflexed to reduce drag. Inboard flap sections are double-slotted, full Fowler motion types. Outboard sections are also double-slotted with half Fowler motion.

Convair claims the 990 can land and take off from most airports used by four-engine propeller-driven transports, which would make jet service available to many cities that lack airports large enough to handle the jets now being used by airlines.

Convair officials report that the modular replacement philosophy of military aviation has been adopted in the 990 to keep down the time and cost of maintenance. Access doors make up 12% of the fuselage surface and almost 35% of its lower wing surface to speed removal of faulty units and the installation of replacements. Quick-disconnects are used in engine pod wiring, plumbing and structural attachments.

The General Electric aft-fan engines are reported to be 40% more efficient than the military J79 turbojet on which they are based. Diameter of the engine pod is nearly 6 ft. Steel clamshell thrust reversers form the external surface of the aft end of each engine pod when the reversers are in the cruise position. Mixing between the engine exhaust and the low velocity annulus of fan wash so reduces engine noise that additional sound suppressors are not used.

The basic 990 carries 15,110 gal. of fuel. The Coronado 990 carries 15,675 gal. and has full provisions for overwater service. The speed capsules on the wings are used for fuel storage. The 990 can accommodate 96 first-class passengers in four-abreast seating, 121 coach class in five-abreast seating, or almost any number in between in mixed seating arrangements. The cabin fittings are designed to let the airline operator change the mix of first-class and coach seats to meet day-to-day needs.

At 41,000 ft. the cabin of the 990 can be pressurized to the equivalent of 6,000 ft. At 20,000 ft. cabin pressure can be equivalent to sea level. Maximum cabin pressure differential is 8.2 psi.

Convair 990 and Coronado Specifications

Performance	
Cruising speed	640 mph.
Range (full first-class payload, normal reserves, at long range cruise at 35,000 ft.)	4,300 stat. mi.
Stalling speed (landing configuration)	105 mph.
Maximum cruise altitude	41,000 ft.
Rate of climb (sea level, normal power, takeoff weight)	3,250 fpm.
Fuel consumption (30,000 ft., average cruise power)	1,530 gph.
Takeoff, CAR runway for 2,000 stat.-mi. trip	5,350 ft.
Takeoff, CAR runway for 1,000 stat.-mi. trip (Sea level, standard conditions)	4,600 ft.
Landing, CAR runway	4,770 ft.
Capacities	
Passengers, all first class (all coach: 121)	96
Payload (first class) (coach: 29,245 lb.)	25,120 lb.
Fuel (Coronado: 15,675 gal.)	15,119 gal.
Oil	28 gal.
Cargo	928 cu. ft.
Dimensions	
Wing span	120 ft.
Wing area	2,250 sq. ft.
Length	139 ft. 5 in.
Height over tail	39 ft. 6 in.
Weights	
Maximum landing weight	180,000 lb.
Maximum takeoff weight (Coronado: 244,200 lb.)	239,200 lb.
Maximum ramp weight (Coronado: 245,000 lb.)	240,000 lb.
Maximum zero fuel weight	154,000 lb.

Engines

Four General Electric CJ805-23 aft turbofan jet engines equipped with thrust reversers. Engines rated at 16,100 lb. each.

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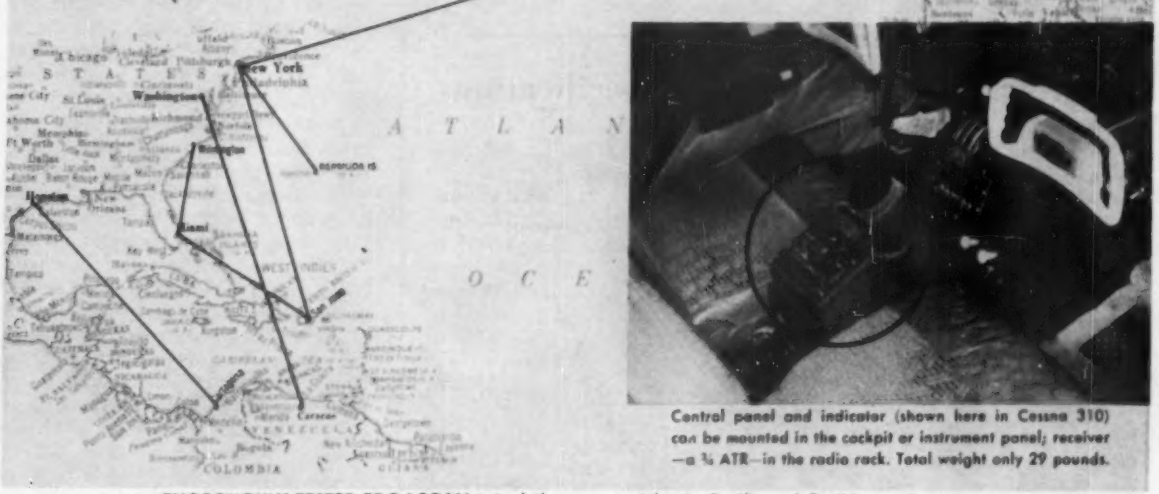

Control panel and indicator (shown here in Cessna 310) can be mounted in the cockpit or instrument panel; receiver —a ¼ ATR—in the radio rack. Total weight only 29 pounds.

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- Eastern Air Lines
- El Al Israel Airlines
- Flying Tiger Line
- Garuda Indonesian Airways
- Iberia Air Lines of Spain
- Irish Air Lines
- Japan Air Lines
- KLM Royal Dutch Airlines
- Lufthansa-German Airlines
- Northwest Orient Airlines
- Pan American World Airways
- Qantas Airways
- Sabena Belgian World Airlines
- Scandinavian Airlines System
- Seaboard and Western Airlines
- Swissair
- Transports Aeriens Intercontinentaux—TAI
- TWA—Trans World Airlines
- Varig Airlines
- Also in use by MATS

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Edo Loran complies with FAA TSO C60

For complete information on Edo Model 345A Loran, send for Descriptive Literature to Dept. C-6.

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Airline Bid Requests Canceled by MATS

Washington—Military Air Transport Service has revoked requests for bids from commercial airlines for overseas transportation of military traffic in 1961 pending further study of its capacity requirements.

Cancellation of the bid requests came after airlines had submitted their bids. It is the result of the presidential order last month directing a cut in the number of dependents of military personnel based overseas.

Commercial carriers have received firm contracts for military traffic for the last three months of 1960, but future contracts will be let by MATS on a monthly basis beginning Jan. 1 when the first of the monthly quota of 15,000 military dependents and civilian personnel return to the U. S.

Industry is still in the dark on the effect the presidential order will have on future traffic potentials, although it is generally conceded that the large-scale recall of some 284,000 persons will create a directional imbalance of passenger traffic until July 31, 1962, when the project is to be completed.

During the third quarter of 1960, commercial carriers transported a total of 138,131 MATS passengers between the U. S. and overseas points in both directions at a contract cost of $13.6 million. Total of 138,131 passengers were military personnel, 61,000 were civilians and 9,448 were members of both categories traveling on a space available basis. Majority of the traffic was transported in charter flights.

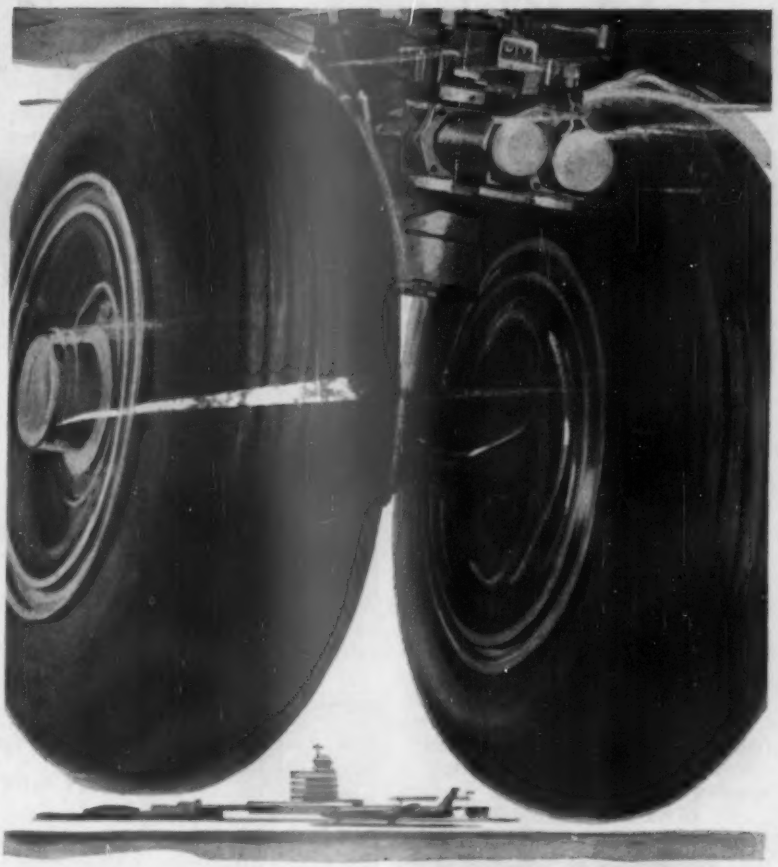
During the 12 months ending June 30, commercial carriers handled a total of 462,254 military passengers under contracts that brought the carriers $47.9 million.

Brancker to Operate Consulting Agency

Montreal—J. W. S. Brancker, former traffic director of International Air Transport Assn., will run Consultair, Ltd., a new consulting and advisory agency in aviation fields.

The company, with headquarters here, will specialize in tourist promotion and traffic development and will provide advisory services to airlines.

Brancker's forced resignation from IATA earlier this year created a wide split between the IATA executive committee, which supported Director General Sir William Hildred's request for the resignation, and a majority of delegates to the association's general meeting in Copenhagen, who wanted to see Brancker retained in the post (AW Sept. 12, p. 40).



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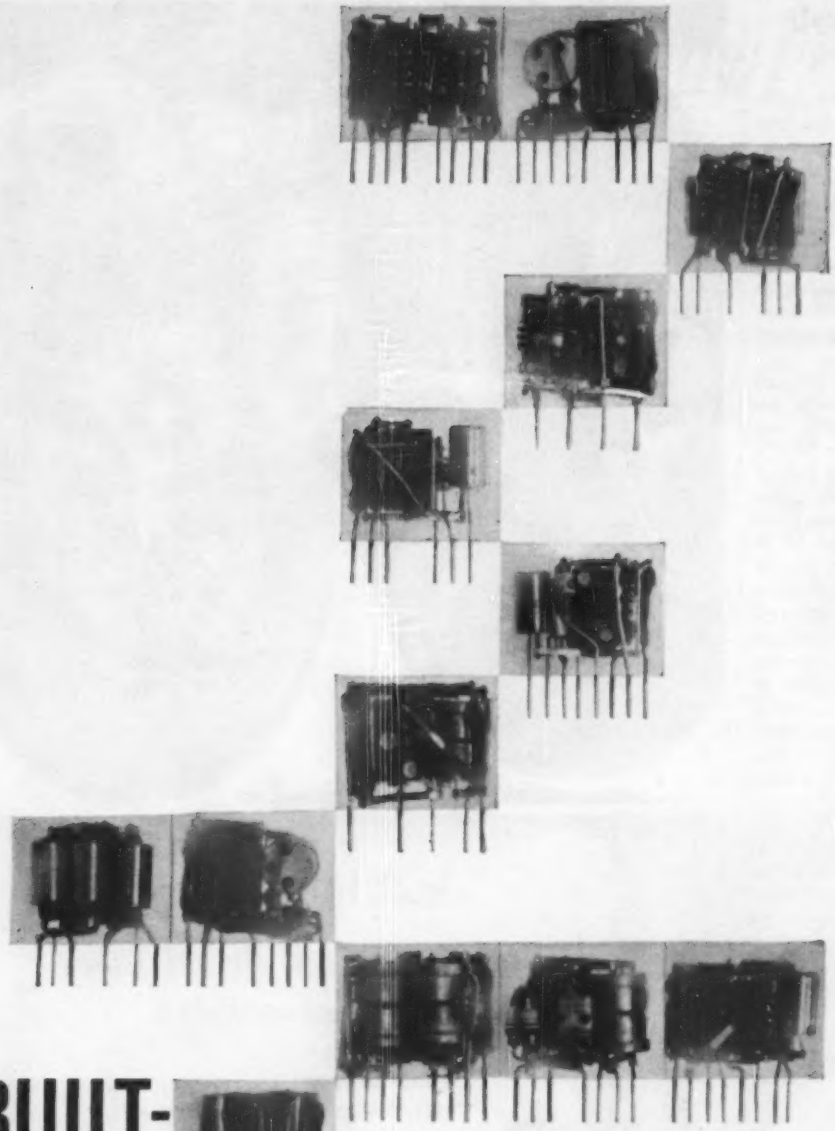

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ALPA Forms New Attendants' Division

By David H. Hoffman

Miami Beach, Fla.—Directors of the Air Line Pilots Assn., deadlocked for four days over what to do with flight attendants, have decided to form a separate stewards and stewardesses division linked to ALPA only by a common president.

The union division established during the closing hours of ALPA's 10-day biennial convention here will be headed by Clarence N. Sayen, acting president of the former Air Line Stewards and Stewardesses Assn. since Rowland Quinn walked out of the pilots' Chicago headquarters last summer.

At all other levels—from the local councils representing individual domiciles to the industry-wide executive committee—pilot and cabin attendant organization will be kept distinct. Moreover, the separate ALPA board of directors retained power to sever even this relationship with associated stewards and stewardesses by a simple majority vote.

Inclusion of this so-called "escape clause" finally resolved the thorny issue by allaying the fears of many pilots who felt that hostesses inside ALPA would play too important a role in shaping association policy (AW Nov. 28, p. 40).

In another controversial area that was dealt with at the eleventh hour, ALPA ruled against making the office of executive vice president elective. Instead, it changed the title of Kay McMurray, Sayen's full-time assistant, from executive vice president to executive administrator. Thus ALPA apparently complied with recent labor legislation requiring that a union's top officials be selected by popular vote.

Cockpit Tape Recorders

On the recommendation of Sayen, the pilots also endorsed installation of sound recorders on airline transports as an aid in accident investigation. Such recorders, according to an explanatory report issued by ALPA's safety engineering department, could become operational within two years.

If data already being supplied by standard flight recorders was supplemented by a recording of all pertinent sounds, cockpit conversation or exclamations during an emergency, the precise cause of at least 16 partially unexplained fatal accidents in the last three years could have been determined, ALPA reported.

To protect pilots' privacy and prevent "the possible misuse of any information for punitive action," the association favors incorporation of an "erasing" mechanism in the sound recording system.

To soften the economic impact of prolonged strikes, or strikes involving more than one large airline, ALPA voted to build up a reserve benefit fund of $750,000. In the event of major work stoppages, this fund would be used to pay the first demands for strike benefits, then replenished from membership assessments.

Thus the necessity of borrowing bank money—even though this is available to ALPA at prime interest rates—would be eliminated. Debate on the reserve benefit fund consumed the better portion of a day, with opponents arguing that the ample association treasury and the availability of commercial money made a "war chest" unnecessary.

Turning to relations with Federal Aviation Agency, the convention noted that the rate and number of infractions charged against airline pilots have increased sharply since promulgation of the Federal Aviation Act in 1958. During the entire period covered by the Civil Aeronautics Act of 1938, only 122 violations were filed against ALPA members. In 1959 and 1960 to date, 121 violations have been filed.

Pilot Protection

To increase pilot protection in violation proceedings, ALPA's standing committee on FAA enforcement procedures recommended a much closer liaison between individual pilots and the legal division of the association.

A pilot involved in any potential infraction, this committee suggested, should immediately seek ALPA counsel, for: "No matter how minor the incident may seem, or how trivial the local officials may make it appear, the truth of the matter is that they do not control the action to be taken. The decision is made in Washington, invariably by men with legal rather than flying backgrounds. Therefore, technical compliance with the law is governing."

Recommendations aimed at accelerating the pace of airways modernization and at achieving greater en route safety were offered the directors by ALPA's air traffic control committee. Among them:

- **Radar should not be used** as a primary means of establishing on-course separation. Rather, greater emphasis should be placed on two-way communications systems even though most aircraft now are equipped with transponder units.
- **Pilots should not be required** to navigate in a terminal zone by reference to streets, parkways or other barely distinguishable objects on the ground. Nor should Air Traffic Control (ATC) require pilots to change en route radio frequencies over geographical landmarks instead of at specified times.
- **Airborne weather radar** should be deemed an acceptable method for determining a course through or around areas of thunderstorm activity.

Ranging beyond specific recommendations, ALPA's ATC committee took note of FAA's effort to develop a control system capable of moving 120 aircraft per hour through an airport. It then termed the effort "ironic" in view of the fact that no known airport design could cope with this volume of traffic.

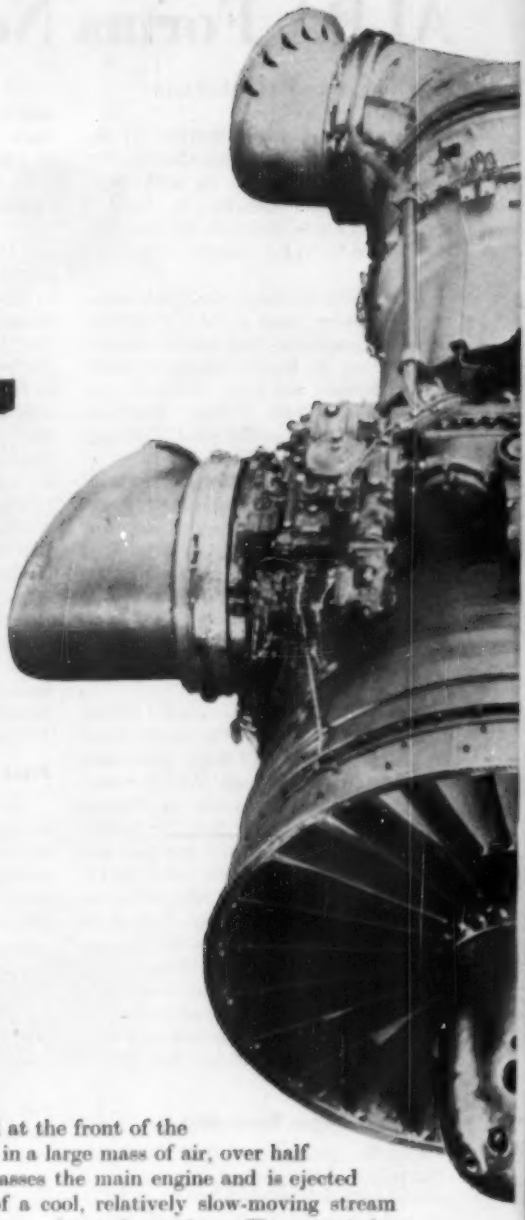
Without objection, the association's directors reaffirmed earlier policy favoring the inclusion of "no strike" clauses in contracts with carriers participating in the Civil Reserve Air Fleet. Such provisions, which would apply only if CRAF were activated, would be aimed at "stifling Air Force arguments concerning the dependability of civilian flight crews in responding to an emergency."

A five-man standing committee to investigate the manner and procedure employed by Department of Defense in awarding MATS airlift contracts was established by the convention.

Debating more than 100 proposed resolutions submitted by the union's far-flung domiciles, ALPA's 300-man board of directors also voted to:

- **Continue electing the association** president itself rather than poll the entire ALPA membership for its preference.
- **Oppose any legislation** that would transfer accident investigation work from the Civil Aeronautics Board to the FAA or "any other federal agency which subsequently may receive the responsibility for promulgation of operational regulations."
- **Maintain the Chicago location** of the ALPA home office rather than move the headquarters to Washington, D. C., as had been proposed by several councils.
- **Attempt to secure legislation** establishing a three-man board to review civil penalties levied against pilots by FAA's administrator and to act as an "evidence-taking body" for the CAB in appeals. All three members of this board would be skilled pilots.
- **Seek further legislation** aimed at shifting to the federal government the economic penalty imposed on pilots who must retire at age 60. This might come through income tax relief or accelerated social security benefits.
- **Step up the payment** of strike benefits to Southern Airways' pilots. The new scale of payments, made retroactive to the strike's 120th day, would increase the amount received by Southern ALPA members by $60 per month, with benefits ranging from $410 to $710 per month depending on the pilot's former salary bracket.

LIFT AND THRUST FROM ONE ENGINE



A single power source for VTOL and STOL aircraft. The new Bristol Siddeley BS 53 high-ratio turbofan represents a major engineering breakthrough in the field of VTOL and STOL aircraft propulsion because it provides the airframe designer with a single power source *for all conditions of flight.*

VTOL, STOL and normal take-off capability. The most revolutionary feature of this unique engine is that the thrust can be evenly applied around the centre of gravity through four movable nozzles which are directed downwards for lift, backwards for thrust, forwards for braking in flight, or in any intermediate direction. This makes possible, for the first time, the design of single or multi-engined aircraft in which the total installed thrust is available for vertical or short take-off with a normal payload or for conventional take-off with a large overload.

High cold-flow ratio, high thrust, low fuel consumption. The BS 53 is a high-thrust engine and the basic design concept which makes its versatile performance possible is a high cold-flow ratio.

A fan, located at the front of the engine, draws in a large mass of air, over half of which by-passes the main engine and is ejected in the form of a cool, relatively slow-moving stream through the two forward nozzles. The remainder passes through the gas generator and supplies thrust to the two rear nozzles. This arrangement greatly improves the Froude efficiency and gives the BS 53 a higher thrust/weight ratio, a lower specific fuel consumption and a lower noise level than any turbojet of comparable power in existence today.

Conventional installation, operational simplicity. The BS 53 is installed normally, with forward-facing intakes and the majority of its components are based on well-known principles already proved in service. These factors make for operational simplicity, easier maintenance, greater reliability.

Reduced problems of ground erosion and recirculation. Because the velocity and temperature of its jet effluxes are low, the BS 53 minimises the problems of ground

THE REVOLUTIONARY
BS 53
TURBOFAN

erosion, recirculation and ingestion of debris which are a major difficulty with fixed lifting engines. All ground running can be done with the exhaust discharging backwards like a conventional turbojet. Taxying also is perfectly normal, and at take-off a short forward roll before the nozzles are deflected downwards ensures that all debris is left behind. As a result, the BS 53 does not require prepared sites and is *independent of all fixed ground installations.*

Selected for the world's first VTOL fighter. The Bristol Siddeley BS 53 has received the support of the Mutual Weapons Development Programme for NATO, and has already been selected for the world's first fixed-wing, aircraft designed for operational service with V/STOL capability—the Hawker P 1127. Although this remarkable engine was primarily designed for this type of aircraft, it is equally suitable for any single or multi-engined, subsonic or supersonic aircraft which requires VTOL or STOL capability.

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AIRLINE OBSERVER

▶ Airline traffic volume may be developing an unanticipated but unspectacular rise during the last six weeks of 1960, following five months of depressed activity (AW Nov. 21, p. 35). Heavy pre-holiday coach traffic coupled with relatively good autumn weather probably accounts for the slight upward trend.

▶ Convair 600 has now been officially redesignated the Convair 990 by General Dynamics Corp. (see p. 40). The change was made without fanfare in a press release on the 600 rollout, and that is about all the manufacturer plans to do to make the redesignation official. Originally, Howard Hughes chose the number 880 for the first of Convair's jet transports and insisted that no higher number be used for subsequent aircraft. Later, American Airlines ordered the more advanced 600 and decided to call it the 990. Swissair calls its intercontinental 600 the Coronado.

▶ Federal Aviation Agency is highly encouraged by initial tests on its shipboard Vortac installation, intended to evaluate feasibility of establishing a network of such navigation aids on weather ships across the Atlantic. Measurements on this initial shipboard installation indicate navigational errors of less than three degrees, comparable to those obtained with land-based installations. Airlines will begin to use the ship-based Vortac soon on a trial basis.

▶ American Airlines will add extra coach seats on its Boeing 707 fleet to increase capacity during the peak holiday traffic period Dec. 18 to Jan. 7. The 707s will operate with 80 coach seats and 40 first-class seats, compared with current configuration of 68 coach, 36 first class. 720s will have 68 coach seats, 36 first class, compared with the present arrangement of 50 coach and 48 first class. Temporary readjustment of seats is based on expected increase in demand for coach seats by passengers traveling for personal reasons and a seasonal decline in those traveling for business.

▶ Canadair CL-44 runway requirements for both takeoff and landing have been improved 11-12% over earlier theoretical figures as the result of recent flight test measurements. Balanced field length for takeoff at maximum gross weight of 205,000 lb. is reduced from 7,660 ft. to 6,800 ft. Landing field length at maximum gross landing weight of 165,000 lb. is reduced from 6,780 ft. to 5,980 ft.

▶ Federal Aviation Agency has been asked to make a simulation study of air traffic control activities in the Berlin terminal area by U. S., British and French forces in the German city. Full-scale study will be conducted with a dynamic air traffic control simulator at FAA Bureau of Research and Development's Experimental Center at Atlantic City. Although Berlin's air traffic is not heavy by U. S. standards, limited space, the need for more modern navigation aids and control equipment and the confinement of traffic to three corridors between Berlin and the West have created problems in the handling of air traffic in the terminal area.

▶ Aeroflot's twin-jet Tu-104s continue to show poor utilization after more than four years of regular service. One Soviet source indicates that Tu-104s employed on the trans-Siberian run average only 150 hr. of flying time monthly.

▶ Northwest Airlines has been making the best of a bad situation resulting from the flight engineers strike which has grounded the carrier's Douglas DC-8 turbojet transports. Three of its DC-8s have been sent back to the Douglas plant for fixes during the strike. These involve installation of leading edge wing tanks and new venting for these tanks. Northwest's fifth DC-8 will come from the plant with the modifications already completed.

▶ Air Traffic Conference last week elected William J. Mitchell, vice president of traffic and sales for Bonanza Air Lines, president of the conference. William L. Morisette, Jr., Eastern sales vice president, was elected first vice president of the organization, and C. Gordon Brown, vice president of Piedmont Airlines, was named second vice president.

SHORTLINES

▶ **Air France** has begun nonstop Sud Aviation Caravelle turbojet service from Paris to Prague, replacing Vickers Viscounts on the route. The French carrier recently took delivery of its 20th Caravelle and increased its order for the twin turbojet from 27 to 33.

▶ **Air-India International** has been recommended by a Civil Aeronautics Board examiner for stopover rights at Dhahran, Saudi Arabia, on flights from India to the U.S. Dhahran also is served by Trans World Airlines, which had no objection to including Air India in the Saudi Arabian market.

▶ **Braniff Airways** inaugurated an all-cargo service last week between Dallas and New York with Douglas DC-6A equipment. The airline has organized a new cargo sales and service department to put new emphasis on cargo and freight activities.

▶ **Capital Airlines** was authorized by the Civil Aeronautics Board to suspend service at Sault Sainte Marie, Cheboygan and Traverse City, Mich., Dec. 1 when North Central Airlines began serving the three cities. Action was part of the decision in the Great Lakes Local Service Case.

▶ **Continental Air Lines** has asked the Civil Aeronautics Board for nonstop rights between several Texas cities in the Southwestern Local Service Case hearings now in progress in Washington. Continental is asking for authority between Dallas-Ft. Worth and Houston and Dallas-Ft. Worth, Austin and San Antonio.

▶ **Federal Aviation Agency** has organized an Airport Defense Planning Section to develop technical guidance for civil airports participating in national emergency plans.

▶ **Mohawk Airlines** has been recommended by a Civil Aeronautics Board examiner for indefinite rights to operate nonstop between Syracuse and New York. The recommendation follows a trial period of three years during which Mohawk's participation in the nonstop Syracuse-New York market rose from 8,033 to 34,814 passengers annually.

▶ **Montreal International Airport** opened its new $30 million facility last week. The new terminal complex and a new 9,700-ft. runway will serve the four Canadian and eight international carriers operating from Montreal. Eastern Air Lines and Northeast Airlines are the U. S. carriers operating at the airport.

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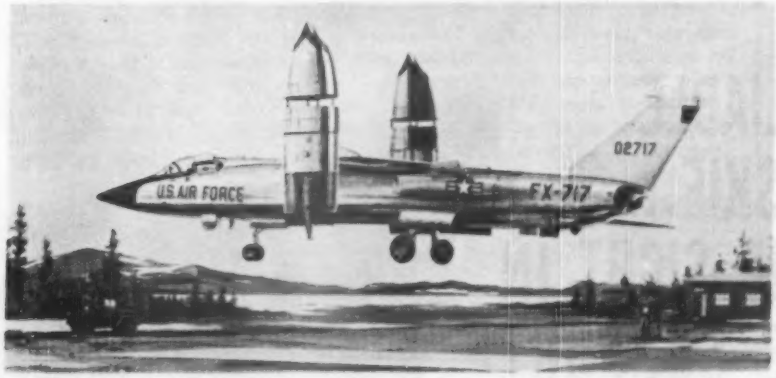
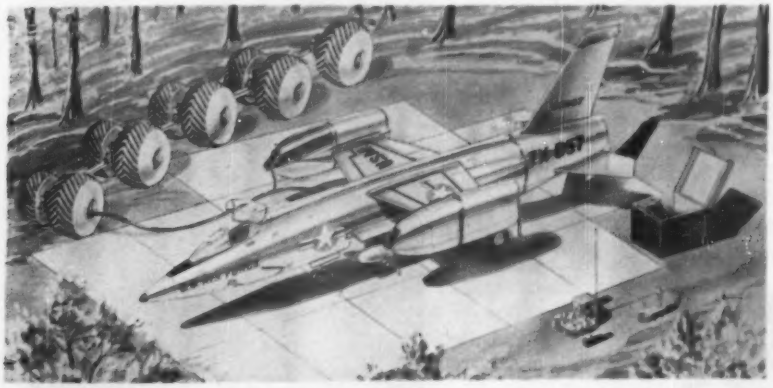
AREA-RULED fuselage of the Bell D-188A Mach 2 V/STOL tactical fighter is shown in cutaway mockup built by Bell. Note the variable wedge that separates the inlets of the two General Electric J85-5s housed in the right wing tip nacelle.

Bell Reveals D-188A V/STOL Details

By David H. Hoffman



D-188A engine nacelles in VTOL flight regime translate forward about 10 in. to create secondary engine inlets for improved efficiency. Wing tip nacelles rotate from horizontal to 10 deg. beyond vertical as required for forward flight propulsion, vertical thrust or braking action. Rotation of nacelles toward horizontal closes secondary air inlets.



ALUMINUM plates capable of quick assembly could form the landing pad for tactically dispersed D-188As. Box at right in artist's concept contained transponder unit that, when interrogated by the fighter's radar, gives location and identification of the landing site. Series of truck-towed wheels seen in the background hold fuel. Bell found that common sod or sand, treated with resin compounds, could serve as a D-188A launching pad.

Buffalo, N. Y.—Development of the Bell D-188A Mach 2 V/STOL tactical fighter, carried beyond full mockup stage by a $17 million government-company investment, now hinges on Bell's success in reviving military interest in the aircraft.

Evolving from an industry competition to design a deck-ready interceptor for Navy and a former Air Force requirement for a V/STOL fighter-bomber (AW Mar. 14, p. 29), the D-188A project, Bell believes, could produce an operational evaluation aircraft in 18 to 20 months.

Bell maintains that this evaluation aircraft, in one sense a prototype, would far surpass all rival VTOL designs in performance. Powered by eight General Electric J85-5 turbojets developing a total thrust of 25,600 lb. on takeoff, the D-188A could:

- **Climb at least 60,000 fpm.** at sea level.
- **Cruise 600 naut. mi.** and return while holding Mach .9 at about 35,000 ft.
- **Accelerate from Mach 1** to Mach 2 in under 2 min. at about 35,000 ft.
- **Have a Mach .9** ferry range of 2,000 naut. mi.
- **Maintain Mach 2** for 340 naut. mi. on a high-speed intercept mission, then return from an altitude top of 60,000 ft. at best cruise.
- **Take off from a short strip,** cruise 570 naut. mi., then hold a Mach 2 dash for 135 naut. mi. before a high altitude bomb drop.

Air Force and Navy have backed D-188A development to the extent of $14.5 million, with the flow of funds

FRONT view of mockup shows one of the two aft engine inlets, which incorporate variable wedges, and stubby, high-mounted D-188A wing.

beginning in 1956 and ending in February, 1959. To avoid dissolving its D-188A design team at this point, Bell invested another $2.5 million—a sum it intends to write off if no new financial encouragement is extended by the military.

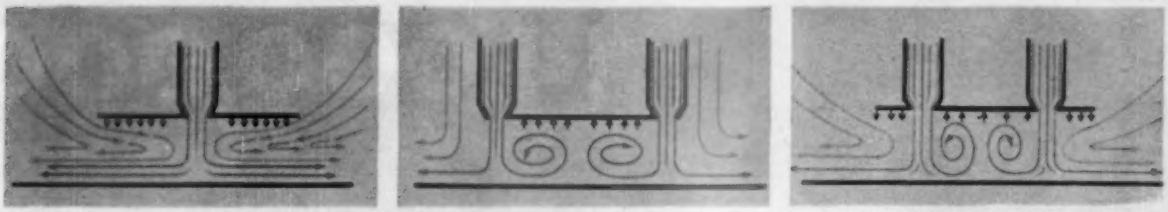
According to Bell, Defense Department's decision to continue or discontinue the D-188A program will decide whether a supersonic VTOL fighter of U. S. manufacture rolls out within the next two years or not until the early 1970s. This timetable finds some substantiation in current Air Force thinking.

Last winter, at the insistence of Tactical Air Command, Air Force ceased implementation of System Development Requirement (SDR) 12, which outlined the need for a Mach 2 VTOL fighter, and superseded it with SDR-17, which calls for an STOL fighter with a 3,000 ft. takeoff capability and a range of several hundred miles while operating below 1,000 ft. at about Mach 1.

STOL Given Priority

Department of Defense, meanwhile, shifted the funds allocated to the VTOL fighter to the STOL aircraft and indicated that these might be increased. In the light of these reshaped requirements, TAC headquarters ex-

COCKPIT of the D-188A features a center panel with all engine instruments on its left, fire control and navigation readouts on its right and radar display at its center. All operating controls are on side panels and consoles. Vertical reading engine performance gages on lower left instrument panel shows rpm, exhaust gas temperature and oil pressure of all eight engines. Aircraft silhouette just above is a cruise and center of gravity control instrument that reacts to each power setting to show fuel remaining, center of gravity location and remaining range capability.



PRESSURE pattern generated by various powerplant configurations is shown above, with black arrows indicating the degree of lift or suction on VTOL platforms. When jet exhaust is ejected from one centrally positioned outlet (left), air is entrained or pulled in from the outside to create a suction effect on takeoff. Center diagram shows ideal situation with wing tip-mounted powerplants and no entrainment. Drawing at right outlines D-188A pressure pattern in actual practice with some suction effects resulting from fuselage overhang.

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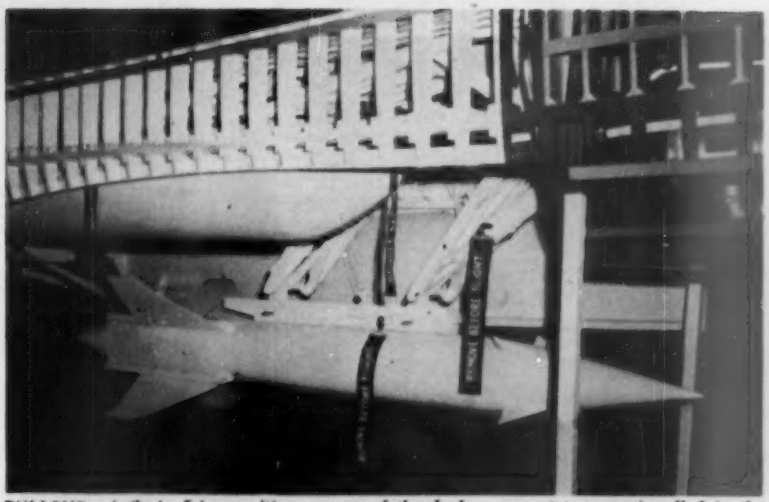
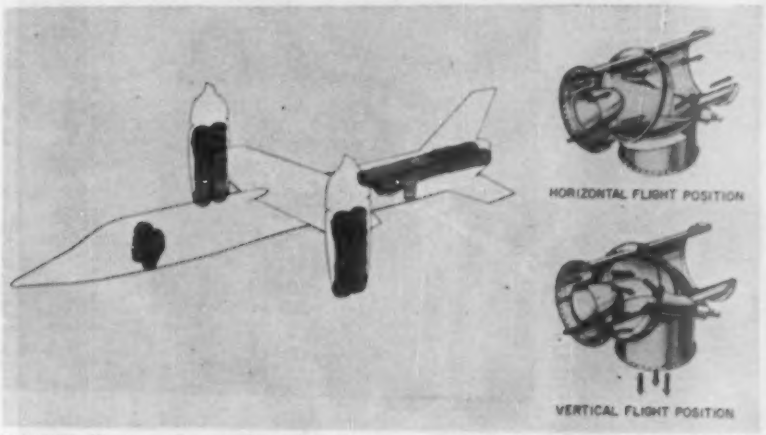


BULLPUP missile in firing position on one of the dual armament trapezes installed in the D-188A's bomb bay. Hydraulically operated trapezes can hold two Bullpups or three Sidewinders or combinations of these with gravity drop weapons.



THRUST diverter valve in aft engine pair permits straight-line efflux for forward flight, directs exhaust downward for vertical takeoff and landing maneuvers. Note the fixed vertical position of forward lift engines in the drawing at left.

pects STOL aircraft to be on hand in squadron strength about 1965, with VTOL fighters to follow sometime after 1970. In the interim, DOD intends to keep some VTOL "study money" circulating in the industry.

Bell, on the other hand, suggests that its D-188A could be "carried along" as part of the STOL development program at an additional cost of only about 5%. Should the military follow this approach, development of a supersonic VTOL fighter could proceed in orderly steps, capitalizing on work done to date, Bell explains.

Specifically, the company is urging Air Force to back the building of 10 D-188As to be used for operational evaluation and to allot funds for a continuing VTOL research program that would include an engine-airframe matching study. Using existing hardware and state-of-the-art systems, the 10 D-188As, according to Bell, could be rolled out within 30 months after contract go-ahead.

Chances that the Air Force will endorse the entire substance of Bell's recommendation appear slim, although the company reports that some encouragement was extended on Sept. 12 by Gen. Frank Everest, TAC's commander. Following a Bell briefing, Everest agreed—for the first time—that the D-188A design concept appeared feasible, even though, in his opinion, the STOL aircraft should command a higher budgetary priority.

Also enhancing Bell's prospects of obtaining new funds for the D-188A is the fact that Air Force has never rescinded SDR-12, its original requirement for a VTOL fighter. Air Force has, on the other hand, upgraded

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D-188A Specifications

Airframe

Gross weight	23,917 lb.
Empty weight	13,791 lb.
Fuel capacity, sea level, standard day	9,840 lb.
Useful load	10,126 lb.
Design thrust/weight ratio	1.03 to 1
Wing span	23 ft. 9 in.
Height over tail	12 ft. 9 in.
Wing area	194 sq. ft.
Wing aspect ratio	2.42
Fuselage length	62 ft.

Engines

Eight GE J85-5s:	
J85-5 thrust with afterburner	3,850 lb.
J85-5 thrust without afterburner	2,500 lb.
J85-5 basic weight	538 lb.
J85-5 lift engine thrust	2,600 lb.
J85-5 lift engine weight	350 lb.

SDR-17 to Specific Operational Requirement (SOR) status, thus bringing it into the short-term planning picture. Short-term planning involves systems "which can be met within present technical capabilities and placed in early production."

In September, Air Research and Development Command requested Air Force to clarify how SDR-12 and SOR-183 (the old SDR-17) would intermesh for planning purposes.

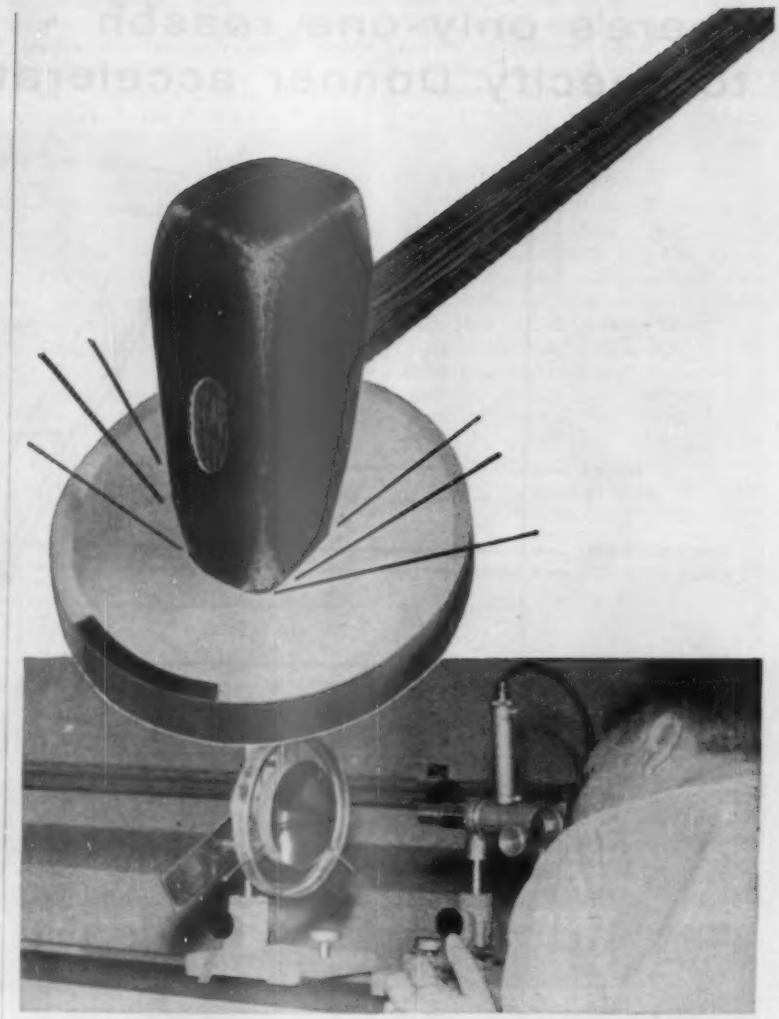
Design Features

Up to now a highly classified project at the Bell Aerosystems Co. plant here, the basic D-188A design incorporates:

- **Eight conventional J85-5 turbojets**—two lying horizontally and parallel in the rear fuselage, two in nacelles attached to each wing tip and two mounted vertically just aft of the cockpit.

All except the forward engines, which furnish lifting thrust only, are equipped with afterburners. During VTOL operation, a mechanical lockout prevents ignition of the aft engine afterburners regardless of throttle position.

- **Wing tip nacelles that rotate** from horizontal to 10 deg. beyond vertical as required for forward flight propulsion, vertical thrust or braking action. In the vertical position, nacelle inlet housings translate upward about 10 in., furnishing the engines with two inlets to improve VTOL efficiency. Rotation of the nacelles toward horizontal closes the secondary air inlets.
- **Reaction control system** for use during VTOL and transition flight phases. To control roll and yaw, compressor bleed air from each engine pair is channeled to four variable-exit nozzles, then ejected through one of six outflow ports to achieve a reaction in the opposite direction. Pitch is controlled solely by modulating the thrust output of the



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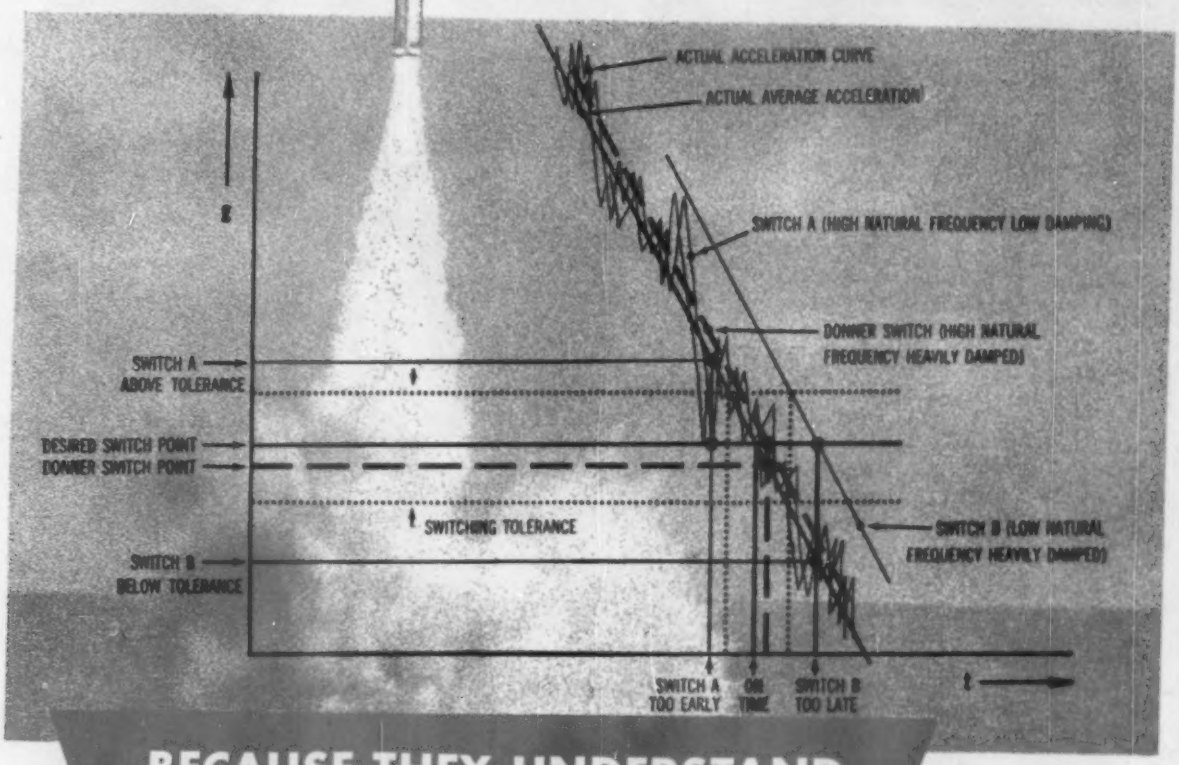
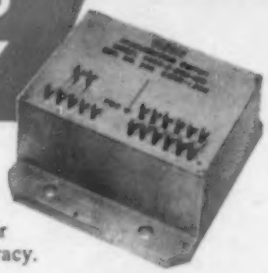


..BECAUSE THEY UNDERSTAND THE MEANING OF ACCURACY



It's dynamic accuracy that counts. In truth, several firms make precision acceleration switches. But accuracy, like reliability, is a term with shades of definition. Some switches are accurate in the lab or on the test bench. That is, they provide *static* accuracy. Donner acceleration switches give you accuracy where it counts, on the operational missile. They are *dynamically* accurate.

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forward and aft engine pairs during VTOL maneuvers.

• **Area-ruled fuselage and thin,** high-mounted wings with a span of 23 ft. 9 in. and no sweepback.

To control the streamlined D-188A platform as it rose vertically from a landing pad, a pilot probably would employ this type of takeoff procedure:

Preliminary checklist complete, he would rotate the plane's nacelles to vertical position and run the four wing tip engines to full afterburner power. The pilot then would activate the reaction control system, ignite the forward lift engines and position a "sugar scoop" thrust diverter in the aft engine pair—all by throwing a two-way switch from "level flight" to "VTO" mode.

Automatically, action of the fast moving thrust diverter is delayed and synchronized to the build-up of power in the forward engine pair. When this valve is allowed to "close," the thrust of all eight engines is directed downward.

Mounted side-by-side near the pilot's left hand are two throttle levers. The four fuselage engines are controlled by the inboard throttle; the four nacelle engines by the outboard.

When the inboard throttle is advanced and the full output of the fuselage engines is added to that of the wing tip powerplants, the D-188A breaks ground. Maximum power application results in an over-all thrust/weight ratio of about 1.03 to 1 and a vertical rise rate of 3 to 5 fps.

At this point, the pilot experiences almost no lag between throttle movement and engine response. He must, however, manipulate the inboard throttle delicately, for thrust output of the typical turbojet varies sharply near 100% power.

Transition Sequence

At an altitude determined by adjacent terrain and by wind and weather conditions, the pilot initiates transition to level flight by momentarily lowering the aircraft's nose to gain forward flying speed. Simultaneously, he gradually rotates the nacelles toward horizontal by applying thumb pressure to a spring-loaded switch on top of the fuselage engine throttle.

Transition complete, the forward lift engines are shut down, the thrust diverter repositioned to allow straight-line flow of aft engine exhaust, and the reaction control system deactivated.

Simple bellcrank assemblies connect the reaction control nozzles with the hydraulically actuated aerodynamic control surfaces of the D-188A. Even when low forward flying speed renders aerodynamic control ineffective, the plane's all-movable vertical and horizontal stabilizers and its spoiler-slot deflectors (which control roll in place of ailerons largely by spoiling wing efficiency) still respond. Stick and rudder pressures position the reaction control system through this linkage.

An emergency shutdown control system connects the eight D-188A powerplants in diametrically opposite pairs. If, during VTO operation, the thrust of one engine falls below a preset level, this system shuts down the malfunctioning engine and its paired mate. Resulting loss of power would cause the aircraft to settle in. But because reaction control air is bled from the nacelle, fuselage and lift engines through common manifolds, no loss of control would be experienced. Not more than .5% of total engine power can be drained off by the reaction control system at one time, according to Bell.

If the D-188A has access to a short runway, its range and payload capabilities can be extended significantly. In this instance, the fighter functions as an STOL aircraft and the pilot employs a somewhat different takeoff procedure, initiating his ground roll with nacelles horizontal and thrust diverter valve open to obtain maximum accelerating force.

Takeoff Technique

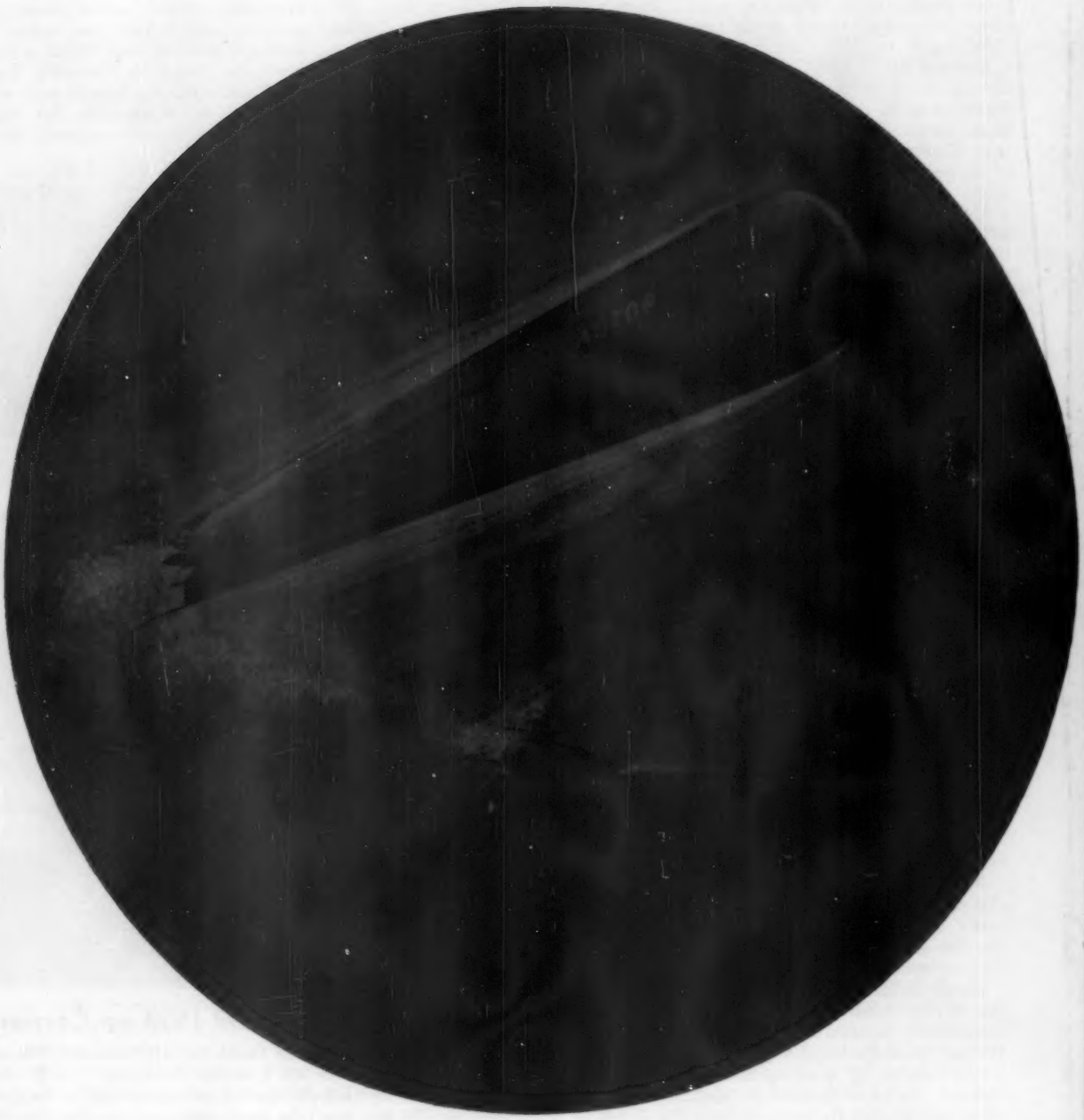
Then, just prior to lift-off, he rotates the nacelles slightly and positions the thrust diverter to direct aft engine exhaust downward. This couples a vertical thrust component with aerodynamic lift to induce rapid takeoff.

As envisioned by Bell, ideal D-188A utilization within a tactical theater involves a central base surrounded by hardened dispersal sites. These, in turn, would be ringed by "austerely hardened" individual reaction sites, all well-camouflaged. At an early alert stage, D-188As would deploy outward. Burn-

French Test Dassault Etendard IVM on Carrier

Dassault Etendard IVM is evaluated on the new French carrier Clemenceau. The strike fighter-interceptor is powered by a Snecma Atar 8 turbojet developing 9,700 lb. thrust. Normal gross weight is 18,000 lb. Hydraulically operated leading-edge flaps can be fixed at 15-deg. or 30-deg. position. The twin nose radar houses radar units one above the other, one being the transmitter unit and the other the receiving equipment. Dassault Aida radar is designed for over-water operation. Buddy-system of in-flight refueling is being developed.

CAPABILITIES FOR DEFENSE . . .



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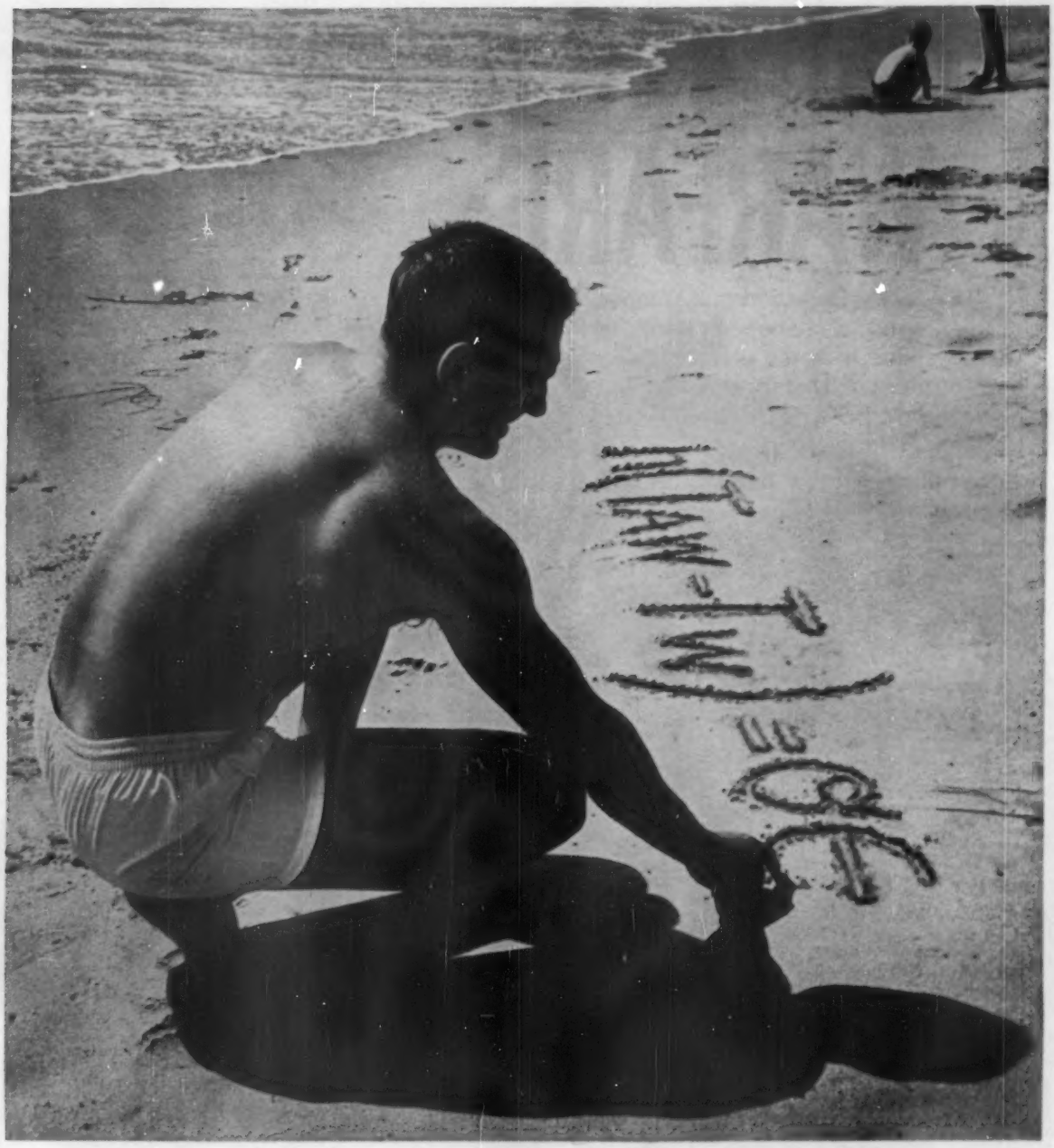

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ing fuel carried in jettisonable wing tanks, the fighters would touch down at their secluded sites ready to depart on a combat mission.

As the degree of D-188A dispersal is increased, the cost of operating the aircraft climbs sharply, for fuel, ammunition and a modest amount of ground support equipment must be prepositioned at the dispersal sites to ensure restrike capability.

But restrike capability, Bell maintains, transforms the D-188A into a far more lethal—and, in the long run, economic—weapon system. About $1 billion, for example, would buy 4.7 D-188A wings and pay their operational and maintenance costs for a year. If deprived of restrike capability and operated from a central base, these could strike, and presumably destroy, about 325 potential targets.

Only 3.4 dispersed wings could be had for the same $1 billion. But second strike capability would so multiply their effectiveness that these could destroy 325 potential targets, explains Bell.

Original D-188A design concept called for a thoroughly integrated weapon system with a maximum speed of Mach 2.3 to fulfill the requirements of SDR-12. Under an agreement with Bell, the Convair Division of General Dynamics was scheduled to be prime contractor (AW Feb. 9, 1959, p. 28).

This partnership lost substance, however, when Air Force shifted its support to larger, longer ranged STOL aircraft. Bell, as an aftermath, backed off from the Mach 2.3 weapon system to the plane it now seeks to sell to the military—a Mach 2 evaluation aircraft that would use on-the-shelf hardware and production engines.

Thrust/Weight Ratio

The D-188A's unusual powerplant configuration illustrates several key problems faced by designers working within the state-of-the-art on high performance VTOL aircraft. Of these, engine thrust/weight ratio universally is ranked number one in importance.

Today, relatively small turbojets such as the J85 offer the highest thrust/weight ratio available to the industry: about 8 to 1. Not until 1965, Bell predicts, will non-afterburning engines reach ratios of 10 to 1. Lift engine ratios may climb as high as 15 to 1 during the next five years, but the thrust that they generate only is valuable during VTOL maneuvers.

By contrast, a total thrust/weight ratio in the magnitude of 12 to 1 would be required by a 70,000 lb. gross weight fighter-bomber carrying half its own weight in fuel. A significantly lower ratio, according to Bell, would drain effectiveness from the weapon system by limiting its range and payload.

By placing all powerplants on the D-188A's extremities, Bell found that it could take fullest advantage of the ratio offered by the J85-5; about 7 or 8 to 1. Thus the fighter's center of gravity (CG)—where, pound for pound, load least upsets balance—is left open. The result is a bomb bay bisected by the plane's CG and spacious enough to hold a spare J85.

Design also eliminates much of the weighty ducting ordinarily found in a fighter's fuselage, thereby improving over-all thrust/weight ratio. Of equal or greater importance are the optimum under-aircraft pressure patterns that form when the D-188A operates in the VTOL flight regime.

More Powerful J85-5

In giving the D-188A's expected performance, Bell is banking on a somewhat more powerful version of the J85-5 than those that have earned ratings to date. That such engines will be forthcoming is supported by General Electric static tests, which indicate that substantial growth potential is inherent in the compact J85 powerplant.

For example, an afterburning J85-5 rated at 3,850 lb. thrust recently produced more than 4,000 lb. thrust during the manufacturer's qualification program. "Dry" output of the engine, rated at 2,500 lb. thrust, was boosted to 2,600 lb.

Total engine thrust output controls the maximum gross weight of a VTOL aircraft with absolute finality, for, by definition, the VTOL platform must break ground while aerodynamic forces are zero. Work with the "Air Test Vehicle" and the X-14, two earlier VTOLs designed and flight tested by Bell, has convinced the company that conventional turbojets are well suited for both vertical takeoffs and for most supersonic missions imposed on a VTOL fighter-bomber.

To design new turbofan or bypass engines for VTOLs merely because such powerplants offer improved specific fuel consumption probably is unnecessary, James A. O'Malley, Jr., Bell's assistant chief engineer, has reported. This, according to O'Malley, is because the performance made possible by the average new turbofan's 10% better fuel economy can be matched by a 2.5% increase in the thrust output of standard turbojets on a VTOL.

A thrust increase in this range would enable a VTOL aircraft carrying 35% of its gross weight in usable fuel and 25% of its weight in cruise fuel to extend its cruising radius 10% without resort to radically changed powerplants, O'Malley maintains, adding, "A 10% augmentation of takeoff thrust provides approximately 40% more cruising fuel in most systems.

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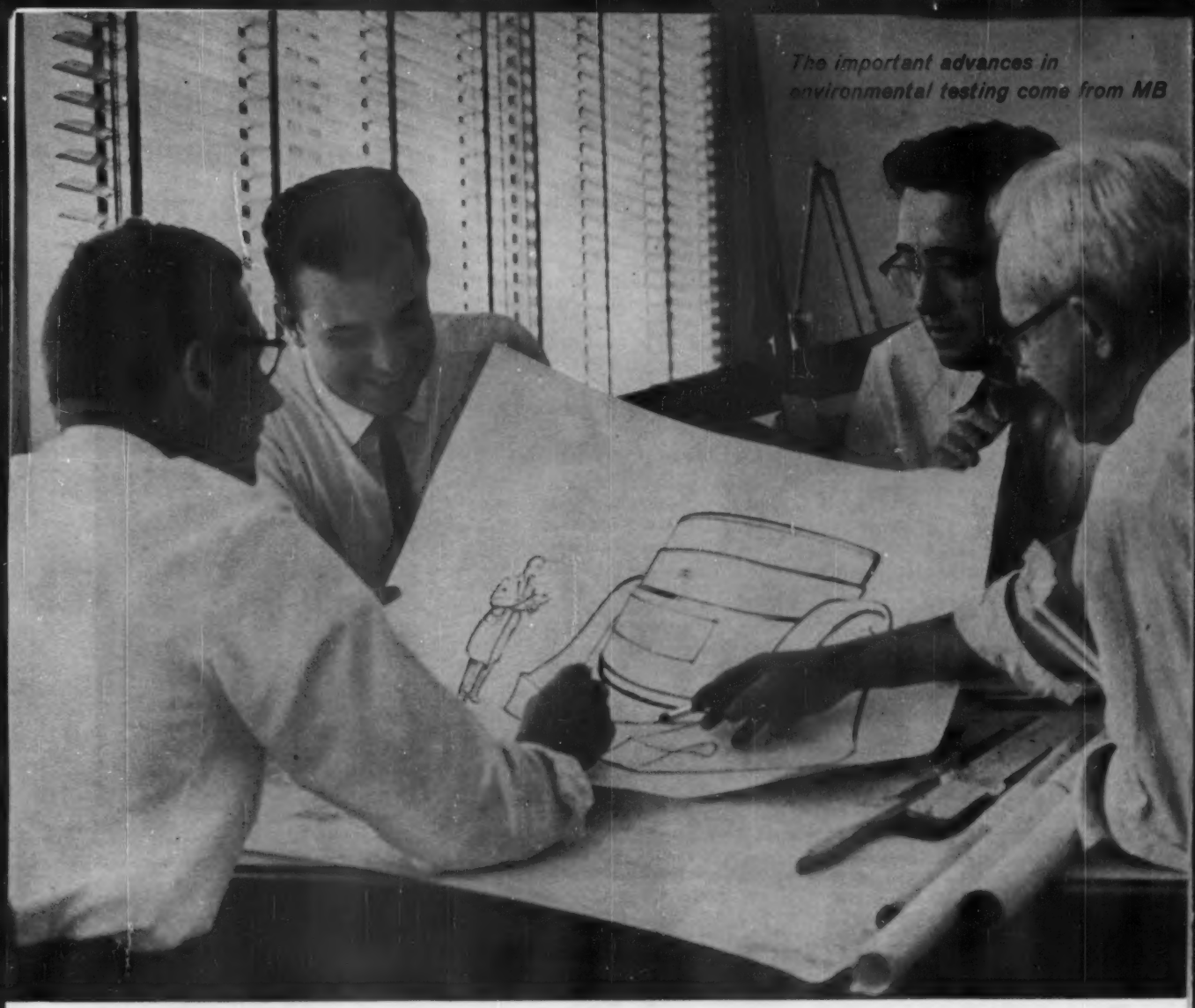

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Other Problems Solved

Although engineers still wrestle with the overriding problem of engine and aircraft thrust/weight ratio, several other VTOL problems, almost equally baffling a few years ago, have been solved by Bell. These revolve about the temperatures and the pressure patterns generated by jet engine exhaust directed downward and the erosive effect of the efflux on launching pads.

After more than 1,700 test runs with a jet test stand, Bell concluded that common emericrete brick could withstand the 3,000F temperatures produced by the afterburning J85-5s on the D-188A's wing tips for long periods of sustained operation. Moreover, Bell found that common sod or sand, when treated with one of several resin compounds, could serve as a D-188A launching pad. If small aluminum blast plates, just large enough to shield the area of direct exhaust impingement, were placed on the treated sand, no deterioration occurred even though Bell's testing simulated hundreds of D-188A takeoffs.

In considering the erosive effects of the D-188A jet exhaust, Bell believes, the speed with which the aircraft can become airborne is of paramount importance. Thus O'Malley explains: "The D-188A is capable of starting its engines and performing all preflight checks prior to any impingement except from the forward fuselage, non-afterburning engines. As the engines are rotated, the airplane is ready for takeoff and will start into vertical ascent within two seconds of the time afterburning power is applied." Total time for the aircraft to reach 50 ft. is about 1 min.

With the same test rig, Bell simulated the temperatures likely to result in the area surrounding a D-188A running up at full power just prior to takeoff.

In general, it found that despite the 3,000F temperature of the wing tip exhausts, radial temperatures taken at ground level did not exceed 300F beyond a 20 ft. radius.

Temperatures measured 80 in. above the ground held below 100F outside this radius. Thus Bell concluded that high velocities and high temperatures would not exist at the points where jet exhaust struck the ground under the aircraft.

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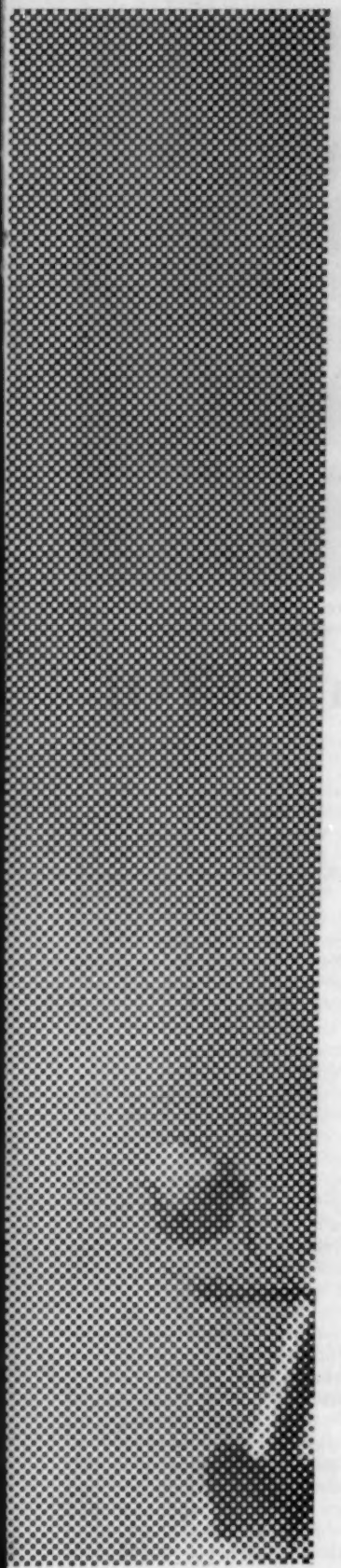

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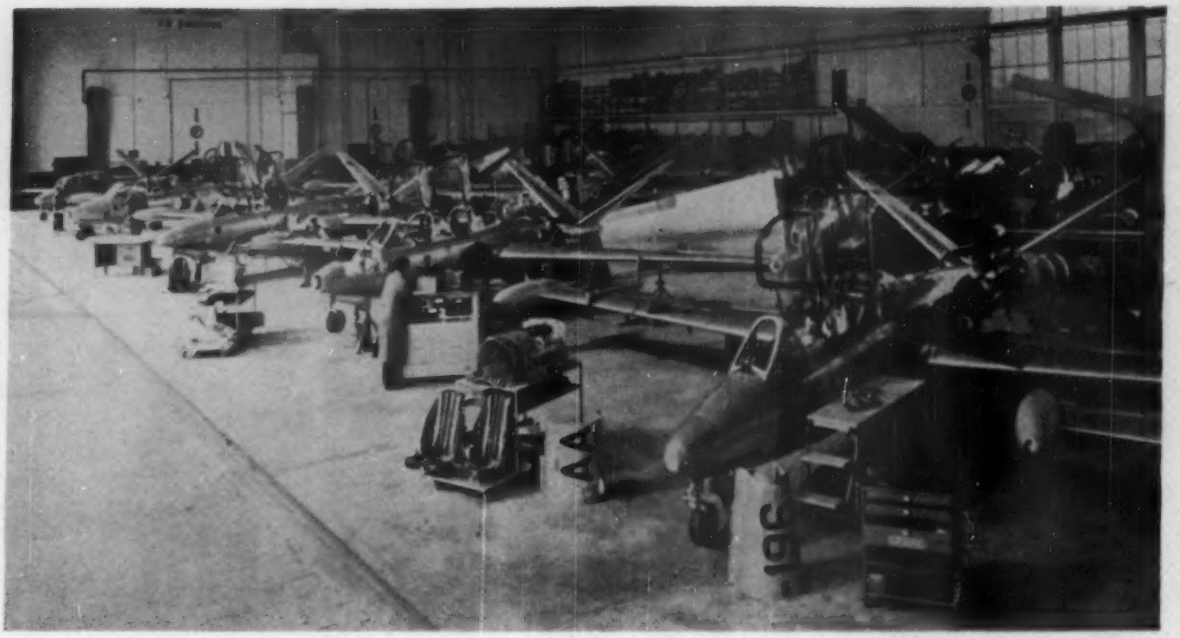


WEST GERMAN industry received its initial boost toward post-World War II activity when it received production rights for France's Fouga Magister trainer. Here, fuselage assemblies made by Messerschmitt are being mated with wing and tail sections built by Heinkel.

German Industry Studies Mach 3 VTOL

By Cecil Brownlow

Bonn—West German air force research planners, looking beyond the conventional, licensed-production aircraft its industry is still tooling to build, hope to make the next step to a wide-ranging family of VTOLs.

The VTOL projects include the much-discussed Mach 3 interceptor—the only one as yet beyond the preliminary planning stage—a close-support aircraft designed to attain supersonic speeds at near ground level altitudes and a transport small enough to be secured in forest clearings but large enough to carry a multi-ton payload over tactical-range distances.

Technical requirements for the close-support fighter as a successor to the Fiat G. 91 are now being studied in a cooperative effort by Germany, France, Italy and Great Britain. Once the details have been agreed upon, they will be submitted to the North Atlantic Treaty Organization for approval.

If such approval is gained, Germany is counting upon a common development and production effort divided evenly among the four sponsoring nations.

One possibility is a successor to—or an advanced version of—Britain's Hawker P.1127 fighter project, which West German officials term "a very interesting research aircraft."

If agreement can be found on the need, substantially the same plan will be followed in the evolution, development and production of the VTOL transport.

With these projects, Germany is strengthening its role in determining the equipment needs of the West European allies as well as bolstering its own industry, placing it in a position to bid on hardware stemming from NATO requirements rather than accepting the hand-me-downs of other nations as it has been forced to do in the past. These bids, and any resultant production, mark another turning point in this country's return as a leading, if not predominant, force within the West European aviation community.

F-104G Replacement

VTOL designs to replace the Lockheed F-104G all-weather interceptor and fighter bomber, the G. 91 and the Noratlas Transall transport will be needed within the next 6-10 years, West German air force research and development officials believe.

The reasons—dispersion and an end to reliance upon vulnerable hard-surface runways—are obvious and more urgent here than in the U. S. An added factor is that in Germany, with an average of 550 people per square mile, land for airports is hard to find, even harder to obtain.

Evolvement of possible plans for these vehicles within West German development circles signals the first bending of the umbilical cord that has fed new life into a once seemingly dead industry.

The umbilical cord was, and is, licensed production, beginning with the relatively simple Fouga Magister trainer and now progressing to the G. 91 and the infinitely more sophisticated F-104G. These agreements, plus close contact with other Western powers on the research and development level, have helped West Germany bridge the gap created by 11 technological years lost between the end of World War II in 1945 and 1956 when, at NATO and U. S. urging, its industry began to emerge again as an entity.

However, for the moment at least, there is no thought of completely severing the cord. German planners are still relying heavily upon U. S. experience, preferring to jump research and development pitfalls that have been traversed by others rather than remaining forever a step behind by insisting upon personally suffering every jolt as some other Western nations have done.

On the horizontal-takeoff Mach 3 VTOL, for instance, the Messerschmitt-Heinkel-Bölkow design group has worked closely with a number of U. S. firms, including Boeing, Lockheed and Martin, and is willing to work with more if they have anything to offer.

The team also recently asked Bell Aerosystems Co. to contribute its design experience from the supersonic Bell D-188A (see p. 54), which has reached the mockup stage before the flow of

U. S. Air Force development funds was halted in early 1959. The variable sweep concepts for high-speed VTOL vehicles evolved by National Aeronautics and Space Administration's Langley Research Center (AW Apr. 4, p. 32) have been extensively reviewed.

In preparing its entrant for the NATO competition, the group has reviewed well over 100 VTOL designs and concepts.

In another effort to move fast, the group hopes to adopt USAF's "Make or Buy" principle, extending it beyond national borders, and it is planning the aircraft as a whole around the weapon system concept.

For an autopilot—as an example of the scope of its "Make or Buy" concept—the group is evaluating units from five companies representing three nations, including the U. S.'s Minneapolis-Honeywell, Lear, Inc. and Perkin-Elmer.

Dr. Robert Lusser, technical director of the group housed in a section of Munich's rambling Deutsche Museum, worked for Messerschmitt before and during World War II on such projects as the Me-109, then moved to the U. S. to conduct research work at the Navy's missile center at Pt. Mugu, Calif., and later at the Army Ballistic Missile Agency in Huntsville, Ala. Approximately two years ago, with U. S. blessing and as an American citizen, he returned to Germany to head the Mach 3 design team.

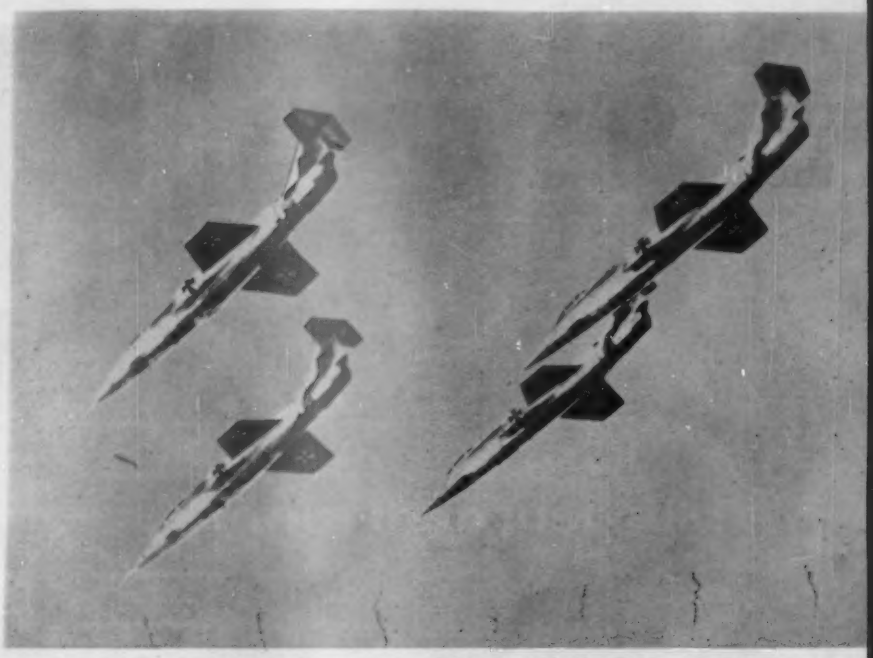
Breaching the Gap

Original design work in Germany plus its growing industry do not necessarily mean an end to major aircraft procurement elsewhere. The air force Training Command is anxious for an aircraft to breach the gap between the Magister primary trainer and Lockheed's T-33 basic trainer on the one hand and the G. 91 and F-104 on the other.

Present planning, for example, calls for pilots to move directly from the Magister to the G. 91—a large step. T-33 instructors who receive student pilots trained on the French aircraft already complain that the cadets have difficulty transitioning because the Fouga is "too easy" to fly and instills a false sense of "jet-experience" confidence. The instructors, strangely, prefer students coming to them from North American's World War II T-6 trainers who have never flown a jet before stepping into the cockpit of a T-33.

One possibility being considered to fill the gap between the Magister and the G. 91—if money can be found—is the Cessna T-37. So long as the supply holds out, the air force will select only seasoned operational jet pilots for F-104 training.

The air force also has obtained rights from Sikorsky Aircraft Division of



GERMAN air force instructor pilots, all with a minimum of 250 hr. on operational jet aircraft, are now being trained on two-seater versions of the F-104. They, in turn, will train the more than 1,000 pilots needed to man the all-weather F-104G interceptor-fighter bomber to be built for the air force under license in West European factories.

HEAVY TOOL industry also is making a rapid comeback in West Germany. Hydraulic press above is being used to stamp out parts for the Fouga Magister and Fiat G.91.

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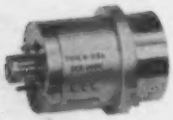

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United Aircraft Corp. for the Bremen firm of Weser Flugzeugbau to build two German prototypes of the turbine-powered version of the S-64 Flying Crane. If the two vehicles meet German expectations, others probably will be built here under license for use by the air force as personnel transports and cargo carriers. Production also may later be extended to turn out S-64s for Army and Navy use.

German officials have made studies of the S-64 powered by a twin-turbine installation of Pratt & Whitney JFTD-12A-1 powerplants of 4,050 shp. each and by two and three-engine clusters of an advanced version of General Electric's T64 with 2,850 shp. each. Whichever engine is chosen, the German government probably will purchase it directly from the primary source rather than asking for license rights.

Missile Production

Although working within the NATO framework on production of missiles and components in the smaller size range—the air-to-air Sidewinder and the Hawk low-altitude anti-aircraft missile—West Germany, now, apparently has no plans to get involved with the development of larger vehicles of this sort.

Dr. Theodor Benecke, chief of West German air force research and development, says that, for the present, "we have no requirements of our own in this field. We are only following NATO recommendations. We do not go out and say 'we need these and these rockets.'"

Before and during World War II, Benecke adds, "our experience was great in this area, but now the U. S. and United Kingdom are much advanced, and we are following their lead."

The West German government, however, is establishing an Institute for Space Flight within the civilian-run German Research Institute at Muhlheim Ruhr. The institute, Benecke says, should be compared in size and scope with a National Aeronautics and Space Administration laboratory rather than with NASA itself.

After research in biomedical and other fields, working in collaboration with NASA, the institute will determine if it can make "some special contributions" to the Western space program.

But, thus far, most of West Germany's effort has gone into manned aircraft, and Dr. Benecke says the air force and industry have moved almost hand-in-hand in three progressive steps since both were resurrected in early 1956.

In the first step, former Luftwaffe pilots, retrained by U. S. Air Force instructors, began flying aging U. S. equipment, notably the Republic F-84 series. At the same time, industry began

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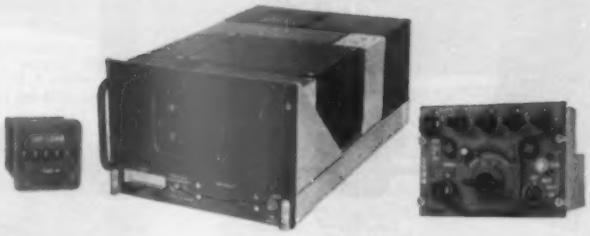

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reacquiring its touch with the licensed production of the Magister trainer.

The second step is now at hand—licensed production of the F-104 and G.91, but with each retailored to fit the specific requirements of the German air force. The "G" in F-104G, Dr. Benecke says proudly, "is for Germany."

Third step, of course, is original development work on the VTOL family, which may lead to West German pilots flying largely German developed and produced aircraft. In this field, Dr. Benecke emphasizes that the Germans plan to continue to work closely with France and Italy, "each utilizing our special talents," and with British industry. The West Germans and Britain already have evolved an agreement whereby Rolls-Royce, Ltd., and MAN (Machinen Fabrik Augsburg-Nuremburg) will work on the joint development of an advanced powerplant package for the Mach 3 VTOL.

Dr. Benecke, as chairman of the NATO Air Committee formed to establish future requirements, firmly believes in the need for three distinct VTOL vehicles to carry out the roles of interception, close support and transport, although he admits that at least one of his colleagues "is not yet convinced." Benecke believes that development of a multi-mission aircraft would result in an overly-complicated vehicle with, at best, marginal performance in each of its fields.

West German officials also hope that, despite recent bucklings in French-German relations on top political levels, cooperation among the technical strata can continue and improve.

As to the potential benefits, they cite particularly the cooperative program now being hammered out anew for the licensed European production of the F-104G by Germany, Belgium, The Netherlands and now Italy (AW Nov. 21, p. 26).

Technical Delays

Technical delays in the production of the F-104G—which, as an electronically sophisticated all-weather interceptor and fighter-bomber is in many ways a new aircraft—and slippages in the performance of some of its components are causing a stretchout in initial production timetables. And, with the first German-produced F-104G scheduled to roll out by December, 1961, at the earliest, the air force is going to be well wide of its goal of 1,000 combat jet aircraft by 1962, or 1963 at the latest. The most optimistic date now seems to be the mid-1960s.

Over-all, the Germans feel that the F-104, which is giving its industry a new technological lease on life, provides an example of what can be accomplished by multi-national cooperation. An official Defense Ministry brochure states:

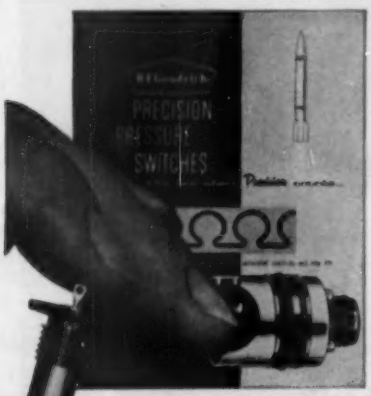
"The equipment program of NATO in Western Europe has so far suffered very much from the lack of uniformity in planning goals and working procedures. The example of the F-104 has now demonstrated the fact that, with some good will on the part of all parties concerned, it is quite possible to pool the various interests of the West European NATO nations and that such action also produces favorable economic and political results."

Aside from the technological gains achieved, the F-104 and G.91 production programs are giving a substantial economic boost to the West German aviation industry as a whole.

Starting from scratch in early 1956, sifting through records of World War II vintage to find capable technicians and managers, the industry has built itself back to an estimated 14,200 employes—13,000 in airframe firms, 1,200 devoted exclusively to engine production.

Government goal, which may well grow, is now tabbed at a total of 26,000 people—20,000 airframe, 6,000 in associated industries.

German firms involved in F-104 production are the Southern Group—Messerschmitt, Heinkel, Dornier and



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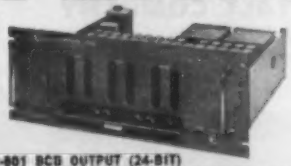

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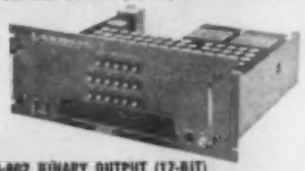

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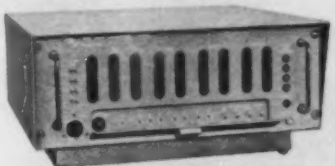

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Day-of-year plus time-of-day. Proposed Inter-Range Instrumentation Group formats. ZA-810 used by NBS on WWV. Either model, $10,100

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Siebel—which will build 210 aircraft, with Messerschmitt responsible for final assembly and flight test; the Northern Group of Focke-Wulf, Hamburger Flugzeugbau and Wesserflug which will aid two Netherlands' firms in turning out a total of 375 airframes, and BMW Triebwerkbau GmbH. which, with Belgian National FN and Fiat, will manufacture under license the General Electric J79 turbojet engine.

Approximately 230 aircraft are involved in the licensed production of the Fiat G.91. Dornier, which has final assembly and flight test responsibility, will build the center fuselage section; Messerschmitt the forward and rear fuselage sections; Heinkel the wing and tail assemblies.

Klockner-Humbold Deutz, of Koln-Deutz, will build the G.91's Orpheus powerplant under license from Bristol Siddeley Engines, Ltd.

With special German requirements—including an emergency fuel system—cranked into its basic design, the licensed model of the G.91 also has undergone its share of growing pains. Rollout and first flight, however, are now scheduled for mid-summer 1961.

As a major contributor to both the F-104 and G.91 programs and producer of over 60% of Germany's fighter planes in World War II, Messerschmitt can serve, perhaps, as an index of the German airframe industry's revival.

Messerschmitt wound out World War II with a staff of approximately 43,000 spread among four main plants, including its headquarters at Augsburg.

For five years afterward it lay dormant, stirring slightly in 1950 with the production of electrical sewing machines at its Augsburg plant, 75% of which was destroyed by Allied air raids during the war, and later following up with the manufacture of enclosed, three-wheel cabin scooters.

Magister Rights

Its real emergence, however, began in the summer of 1956 when the Germans gained license rights to build the Fouga Magister jet trainer, and Messerschmitt gained a major share of the production, as well as overhaul contracts for the air force's T-6 trainers.

Fuselage, including cockpit and electronic installation, final assembly and flight test of the Fouga was assigned to Messerschmitt. The completed fuselage, cut and assembled at a rebuilt Augsburg, was then shipped to Messerschmitt's Munich-Riem Airport for mating with the wing, empennage and nose section fabricated by Ernst Heinkel Flugzeugbau. The Turbomeca Marbore powerplants were supplied from France.

Beginning the operation with approximately 500 employes, Messerschmitt, as G.91 and F-104 orders rolled in, has slowly rebuilt its facilities and increased its employment to the present figure of 2,300.

The final six Fouga fuselages are now on the assembly line, the Magister's blue jigs disappearing in favor of the G.91's green and the F-104's grey, and the final section is scheduled to be trucked to Munich-Riem before the end of the year.

In all, the Messerschmitt-Heinkel combine will have delivered a total of 172 Magisters to the German air force since the first assembly rolled off the production line in mid-1958—another 62 of the trainers were delivered directly from Potez Air-Fouga in the initial buildup stages.

Three Nations

Behind the Fouga come the G.91 and the F-104, three aircraft from three different nations in four years, and, after that, possibly fuselage sections for Germany's own Mach 3 VTOL.

"I began speaking French," one production engineer says, "now I'm shifting to Italian. When you return, my English should be much better."

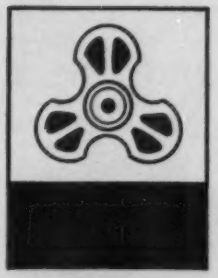
One forward fuselage section, including cockpit, and one rear fuselage assembly of the G.91 already are nudging their way along the final assembly line in Augsburg behind the last six Magisters and are scheduled to be shipped to Dornier within the next two months for mating with their other components. When production is in full swing, the Dornier-Messerschmitt team hopes to turn out an average of seven G.91s per month.

First metal was cut approximately one year ago and, thus far, Messerschmitt's tool shop has turned out over 2,000 jigs for G.91 production. It still has another 500 to go. The first grey jigs for the F-104 also are beginning to appear from the tool shop, which, as in the case of the G.91, has a target of about 2,500.

How Messerschmitt will go in the future still appears to be a question mark. Will it build up its own capacity so that it can handle entire airframes at an acceptable production rate, or will it meld with one or more of its partners in the Southern Group—possibly Heinkel with which it is working on the VTOL? For the moment, no one seems to have the answer. But, undeniably, Messerschmitt is back on its feet, almost ready to stand alone.

BMW offers a similar example in the engine field, where, at present, it is the undisputed leader.

First turning out Rapp four-cylinder, water-cooled engines for World War I aircraft, BMW Triebwerkbau, a subsidiary of the famed automobile firm, had built to a force of 70,000 by 1944, producing, among other things, the



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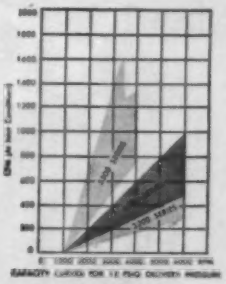
The unique combination of precision manufacture and modern design found only in M-D rotary positive blowers permits higher speed operation and higher pressures. For this reason M-D can furnish greater air flow at lower initial cost.

M-D blowers operate at wider pressure and speed ranges than any other rotary positive blower. Capacities of 22 production models range from 50 to 4,000 CFM, pressures to 14 PSIG single, 70 PSIG multi-stage.



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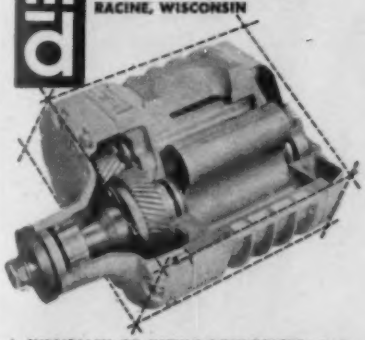

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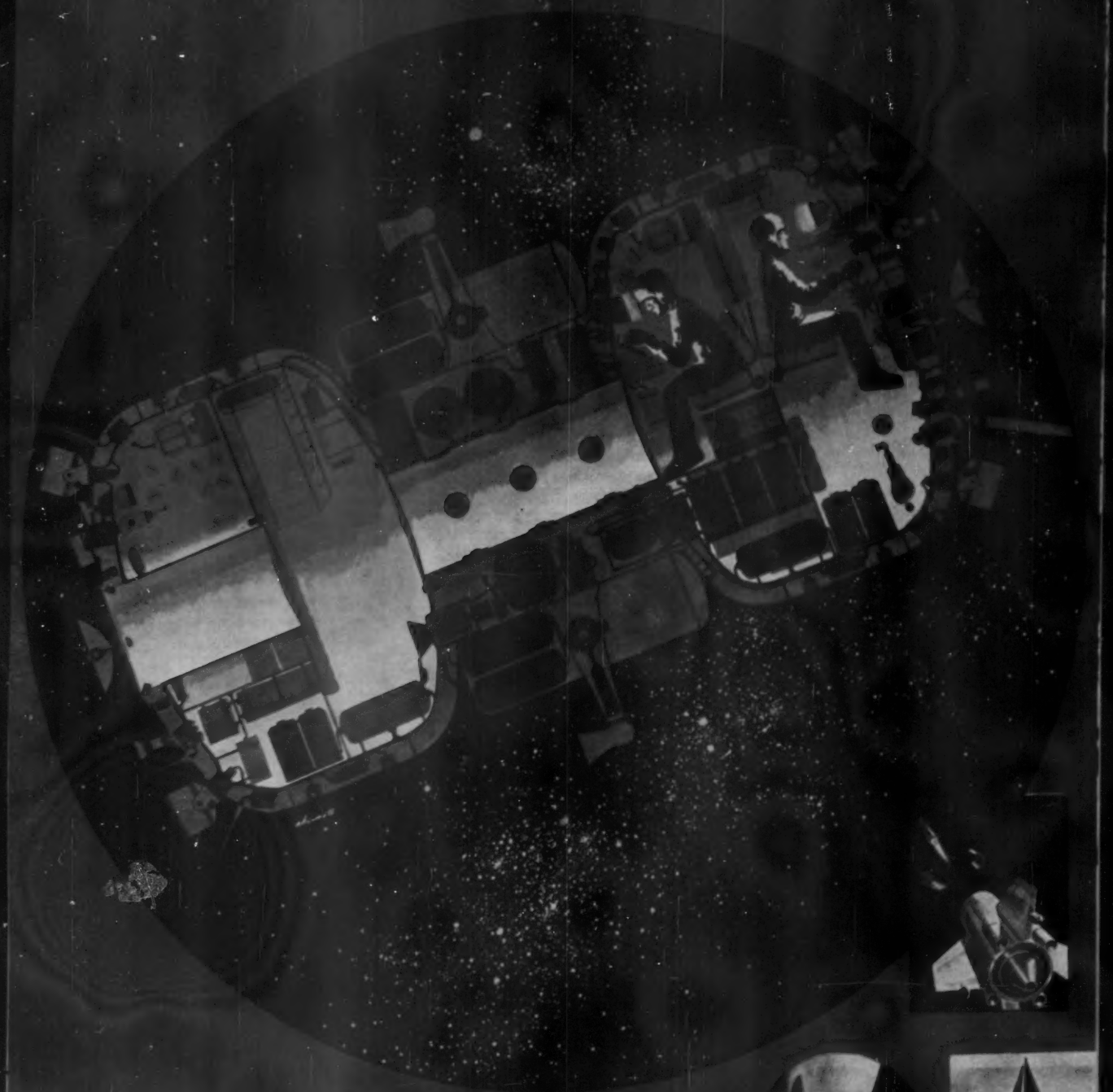
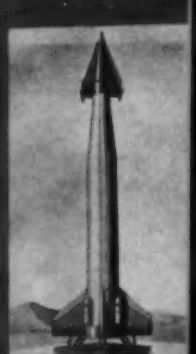
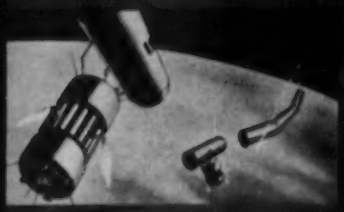
EXPANDING THE FRONTIERS OF SPACE TECHNOLOGY





THE ASTROTUG



Tugboat for Space: Spaceborne scientific laboratories and platforms for further exploration into space are an accepted concept based on established engineering techniques. Components would be fired as individual units into space, on precalculated orbits, and there assembled. To solve the major problems of how men are to live and work in space during the assembly process, Lockheed has prepared a detailed engineering design of an astrotug—a manned vehicle housing a crew of two or three. Missile-launched, the astrotug will be capable of supporting its crew for a number of days in an environment of suitable atmosphere, and with provisions for illumination and adequate food and water.

The Lockheed astrotug is a completely independent working vehicle. Personnel need not leave it in space suits in order to work on the project of assembling the space station components. As shown in the diagram, the tug consists of two double-walled pressure vessels approximately 20 feet long overall and 9 feet in inside diameter. Swivelling rocket nozzles are arranged for maneuvering. On the forward end, extending out are four mechanical manipulator arms with interchangeable "hands" for such specialized functions as gripping, welding, hammering, cutting, running screws, etc. "Hands" can be changed by remote control from inside. Viewing ports provide uninterrupted observation. Radar antennas, searchlights, and other equipment necessary to the tug's work are mounted externally. Main controls and instruments including radar, radio, infrared, computers and navigation consoles are duplicated in each of the two major compartments as a safety measure.

Men working in single units afloat in space suits would have little applicable force and could work for very limited periods of time. With the Lockheed astrotug, personnel could carry on the work in relative safety and comfort with maximum efficiency. A special reentry vehicle, separate from the astrotug, has been conceived for ferrying to and from earth. Tugs themselves would remain floating in orbit indefinitely, being reprovisioned and refurbished as fresh crews arrive in relief.

Space vehicle development is typical of Lockheed Missiles and Space Division's broad diversification. The Division possesses complete capability in more than 40 areas of science and technology—from concept to operation. Its programs provide a fascinating challenge to creative engineers and scientists. They include: celestial mechanics; computer research and development; electromagnetic wave propagation and radiation; electronics; the flight sciences; human engineering; magnetohydrodynamics; man in space; materials and processes; applied mathematics; oceanography; operations research and analysis; ionic, nuclear and plasma propulsion and exotic fuels; sonics; space communications; space medicine; space navigation; and space physics.

Engineers and Scientists: Such programs reach far into the future and deal with unknown and stimulating environments. It is a rewarding future with a company that has an outstanding record of progress and achievement. If you are experienced in any of the above areas, or in related work, we invite your inquiry. Please write: Research and Development Staff, Dept. L-17, 962 W. El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance required.

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MISSILES AND SPACE DIVISION

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Delta's first Convair 880 set a commercial-plane speed record by averaging 667.95 mph on its coast-to-coast delivery flight. Clean aerodynamic lines and snow-white trim mark this sleek 84-passenger jetliner. Electronic-tube complement? G-E 5-Star Tubes in critical sockets of all Delta 880's.

Says **L. G. RODEFELD**, Superintendent of Communications, Delta Air Lines:

"YOU'LL FIND G-E 5-STAR TUBES LIKE THESE IN EVERY NEW, FAST DELTA 880 JET!"

"Part of Delta's pattern of progress, is to feature equipment and components which use has proved exceptionally reliable. On electronic tubes, we keep life records going back many years. We *know* tube performance. Our extensive 'book' on tubes is the reason why Delta's new Convair 880 jets have General Electric 5-Star Tubes installed in vital navigation and communication sockets.

"The same with Delta's DC-8 jetliners and piston-powered planes. Our radar transponders, for example, are virtually 100% equipped with 5-Star Tubes. Here high tube reliability is a major contribution to flying safety.

"Count us as convinced, after many years' experience, that General Electric 5-Star Tubes are a superior product you can rely on!"

* * *

Your nearby General Electric tube distributor has 5-Star Tubes in stock—gives fast delivery service. Telephone him today! *Distributor Sales, Electronic Components Division, General Electric Company, Owensboro, Kentucky.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

231-102

Model 109-003 turbojet engine for the Messerschmitt 262.

Of the seven plants they maintained during World War II, they have regained possession of one located in a remote section of the Munich suburb of Munich-Allach.

Its revival began, haltingly, in 1954 when BMW established a study group to see just what could be done and in which direction. In 1955, with 150 employes, BMW began tooling for the licensed production of 250 hp. Lycoming GO480B-1A6 piston engines for delivery to Dornier for the STOL Do. 27 light plane and to Focke-Wulf for German-produced versions of the Piaggio P. 149 trainer, also built under license. At the same time, it began to repair any and all engines it could find.

Today, with over 1,000 employes, BMW is preparing to build components for the J79 in collaboration with its Belgian and Italian partners and is laying plans for assembly and overhaul of all engines scheduled for the F-104Gs of the German air force. It is still building and overhauling the Lycoming and has an overhaul contract from the West German army for the maintenance of Continental Mark 47 and Mark 41 tank engines.

In addition, in May BMW began to gain new jet experience by overhauling the Orenda engines for German air force Sabre 6s built in Canada. As the air force and BMW gain experience with the engine, it is now rolled in for overhaul after every 300 hr. as opposed to the 400 hr. figure for the Royal Canadian Air Force. As experience is gained, however, the figure probably will be gradually increased to 400 hr.

BMW executives see their immediate future in the design and production of small turbine engines plus the continued licensed production of large powerplants such as the J79 to gain the necessary skills before embarking upon their own.

New Turbine

Their development group already has designed a multi-purpose turbine engine whose horsepower is being boosted from the 60 of two years ago to 100. Versions of the engine already are being tested on a powered glider manufactured by Allgaier in Germany, and others are being offered for such purposes as heat exchangers to warm army squad tents, pipe line pumps and powerplants for ship smokescreen devices.

Within the next year or so, BMW hopes to take a further step with the introduction of a family of 300-to-500 lb. thrust turbojets for small executive aircraft. From there on, the types and thrusts of the various turbine engines will multiply.

PRODUCTION BRIEFING

General Electric's Aircraft Accessory Turbine Department, Lynn, Mass., has received a study contract from Lockheed on the use of a lightweight gas servo system for thrust vector control of Polaris.

General Electric's Small Aircraft Engine Department, Lynn, Mass., has received an order for 15 CT58-100-2 gas turbine engines from Vertol Division, Boeing Airplane Co. Engines, valued at approximately $1 million, are to be delivered starting in mid-1961 and are to be installed in Vertol's 107 turbine helicopter.

Twin Coach Co., Buffalo, N. Y., has received a $666,000 order from Raytheon for electronic consoles for the Hawk surface-air missile system.

NASA has awarded a $500,000 contract to General Electric's Defense Systems Department, Syracuse, N. Y., for radar display and computer equipment. The equipment, to be incorporated into a system called Terminal Guidance and Data Facility, will be installed at NASA's Flight Research Center, Edwards AFB, Calif., for use during tests of the North American X-15.

FLEXIBLE RUBBER COUPLINGS PROTECT FUEL LINES

A new type of lightweight coupling for aircraft fuel lines has the flexibility to withstand bending and torsion that could cause failure in rigid lines. In addition, the couplings are significantly lighter than the metal type. For free literature write:

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aviation products
Dept. AW-12A, Akron, Ohio

PROBLEMATICAL RECREATIONS 43

A candle 15 inches long will burn 9 hours. 1 inch at the lesser end will be consumed in 20 minutes less than the same length at the larger end. How long will it take for an inch at the lesser end to be consumed? *—Ladies' Diary, 1791*

Our B30-ATP Bio-pack, used in medical electronics, incorporates a high-gain, low-noise amplifier and a companion FM transmitter, yet fits in the palm of your hand. Delivery can be made in 45 days. For complete information write to Computer Systems Laboratory, Litton Systems, Inc., 5500 Canoga Ave., Woodland Hills, California.

ANSWER TO LAST WEEK'S PROBLEM: Green Slackens come in whole numbers—at most 18 to the Wallax.

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Every metal cleaning operation has its own particular problems—but they're seldom new to the Detrex engineer. With 30 years of experience, he can produce the right formula to insure maximum productivity and economy in your operation.

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When he gives you his recommendation, you can depend upon it to make sense—and save dollars. And when you put his recommendation into practice, you can depend upon Detrex to follow through with the finest service in the business.

Depend on DETREX for Every Metal Cleaning and Processing Need

- PERM-A-CLOR NA (Trichlorethylene)
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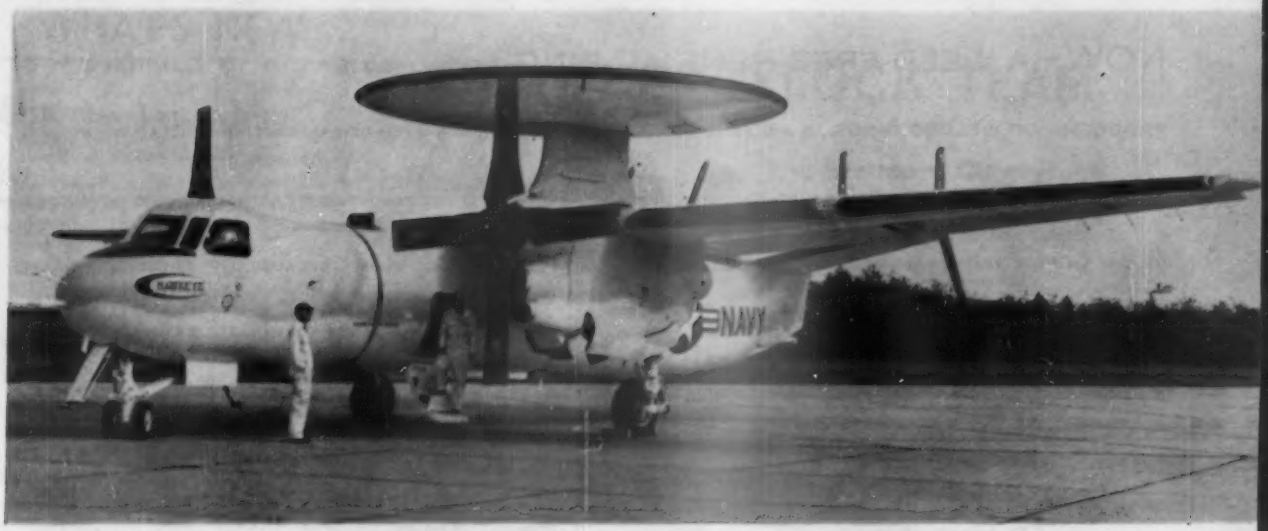
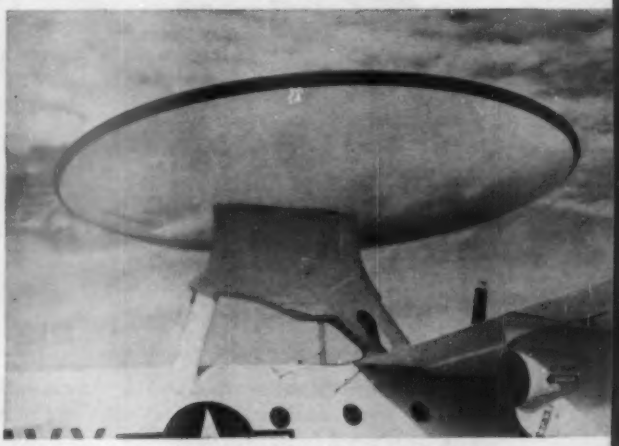
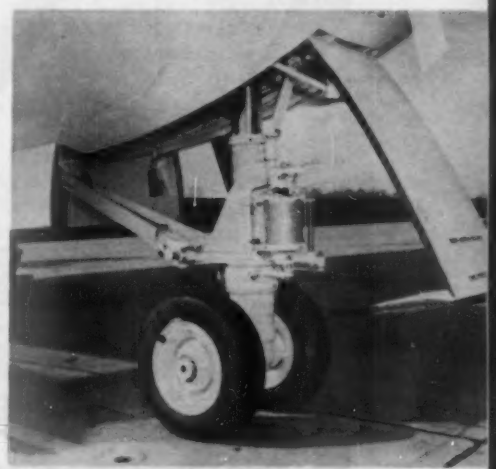


Grumman W2F Hawkeye is marked by its radar rotodome which extends 16 ft. above the ground when in flight position.

Grumman W2F-1 Hawkeye Design Details Shown



Rudder surfaces on all four vertical fins are split to provide increased area for single engine control. Tail bumper (left) has already been struck during takeoff rotation. Rotodome pylon (right) was designed to create minimum drag.



Main gear of the W2F retracts forward and swivels to occupy the nacelle of the Allison T56 turboprop engine. Nose structure and gear are strengthened to withstand stresses caused by the nose wheel catapult launches.

NOW—A WELD-FREE RENÉ 41* RING DEVELOPED BY C-M TO ELIMINATE THE PROBLEMS OF WELDED RINGS.

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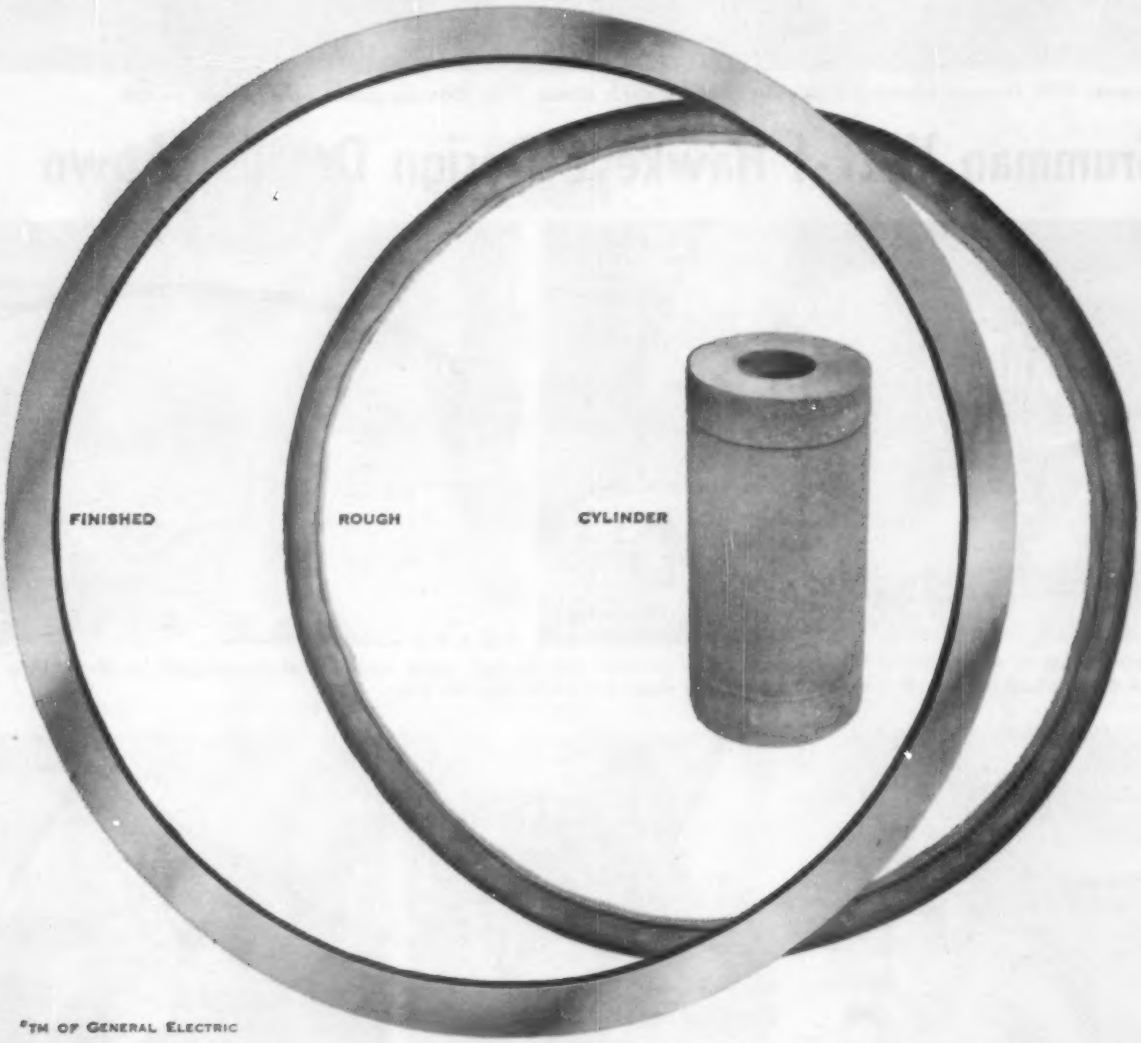

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WHAT'S NEW

Reports Available:

Following reports were sponsored by the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.:

Soviet Military Dictionary—359 page translation by the U. S. Army of Russian operational, tactical and general military terms. $5.00 (60-21783).

Photogrammetry – Bibliography lists technical research reports, translations of foreign literature and government-owned patents available for license. $.10 (SB-416).

Photographic Chemicals and Emulsions—Research reports, foreign technical literature etc. listed in bibliography. $.10 (SB-417) List of 200 OTS selective bibliographies may be obtained on request without charge from OTS.

Physical and Mechanical Properties of the Cobalt-Chromium-Tungsten Alloy WI-52—Defense Metals Information Center at Battelle Memorial Institute. $.50; 21 pp. (PB-161216).

New International Flight Information Manual Issued by Federal Aviation Agency—$.55 from Superintendent of Documents, U. S. Government Printing Office, Wash. 25, D. C.

Cooling Methods and Equipment for Supersonic Aircraft—G. R. Werth and others, Douglas Aircraft Company, Inc., for WADD, U. S. Air Force. Feb., 1960. $3.00; 159 pp. (PB161731).

Instrumentation Package for Inflight Physiological Studies—M. N. Goldberg and others. North American Aviation, Inc., for WADD, U. S. Air Force. Feb., 1960. $2.00; 73 pp. (PB161712).

Synthesis of New High Temperature Materials—J. L. Engelke and others, Stanford Research Institute, for WADD, U. S. Air Force. Feb., 1960. $1.25; 44 pp. (PB161720).

Friction and Wear at Elevated Temperatures—E. Rabinowicz, Massachusetts Institute of Technology, for WADD, U. S. Air Force. Jan., 1960. $.75; 25 pp. (PB161719).

Protective Coatings for Refractory Metals—C. G. Bergeron and others, University of Illinois, for WADD, U. S. Air Force. Jan., 1960. $1.25; 50 pp. (PB161739).

Comparative Properties of Haynes High-Temperature Alloys—Haynes Stellite Co., 270 Park Avenue, New York 17.

THE CHERRYLOCK TEAM

The Standard Cherrylock

Top Performance Through the entire range of Diameters, Grips, and Materials

The Bulbed Cherrylock

Specifically for Thin Sheet and Double Dimple Applications—Even Greater Strength in the Short Grip Ranges

Only the Cherrylock "2000" Team Gives you All These Advantages

- Mechanically Locked Stem
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- Positive Clamp-up
- Full Grip Range
- Complete Hole Fill
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A-286 Stainless Steel—Monel—Aluminum

The Cherrylock* "2000" series team offers the finest, most adaptable aircraft rivets yet developed. Maximum joint strength and reliability are obtained by using the Standard Cherrylock and the Bulbed Cherrylock to cover the entire range of applications. The Bulbed Cherrylock for short grips and double dimple, the Standard Cherrylock in the longer grips. Both types are installed with the same H-610 series pulling head, using existing Cherry guns.

Higher joint strength allowables, close blind side clearance, and the widest grip range available—only with the Cherrylock Team—result in better fastening at lower cost. The Cherrylock Team provides the strongest mechanical lock—flush fracture rivet available. Positive visual inspection after installation—with grip length marked on the rivet head—is offered only by the Cherrylock Team.

* * *

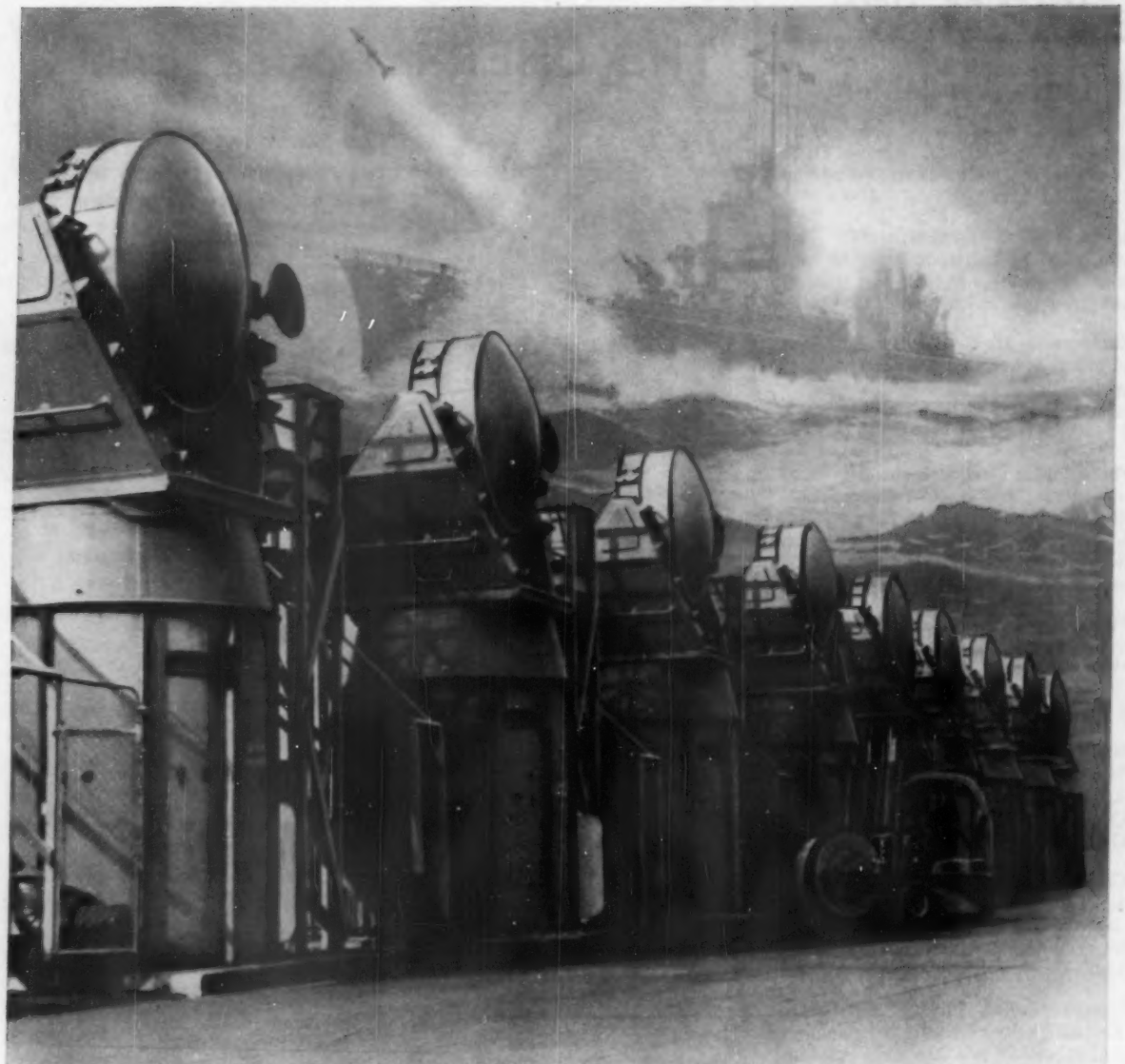
For technical data on the Cherrylock Team of rivets, write Cherry Rivet Division, Townsend Company, Box 2157-N, Santa Ana, Calif.

*Patent No. 2931532

CHERRY RIVET DIVISION

Townsend Company

In Canada: *Parmenter & Bullock Manufacturing Company, Limited, Gananoque, Ontario*



TERRIER RADAR: *For First-Class Missile Marksmanship*

For Navy's deadly surface-to-air Terrier missile, in both its original and its advanced versions, Sperry provides the means of expert marksmanship at sea—the SPG-55 Missile Guidance Radar.

Developed jointly with the Bureau of Naval Weapons, Sperry engineered the design for fast production to meet delivery dates . . . yet controlled the critical quality of these complex, high-performance shipboard radars. Nine units are shown "on the line" above, undergoing final checkout prior to shipment.

The SPG-55 is on duty with the Navy's newest guided missile destroyers, cruisers and carriers, including nuclear class surface ships. Able automatically to acquire, track and guide the Terrier missile to its target, the SPG-55 is part of a fire control complex that incorporates—as well as precision guidance—the most advanced evaluation and computation systems, all produced to highest reliability standards, and on accelerated schedule, by Sperry.

SPERRY

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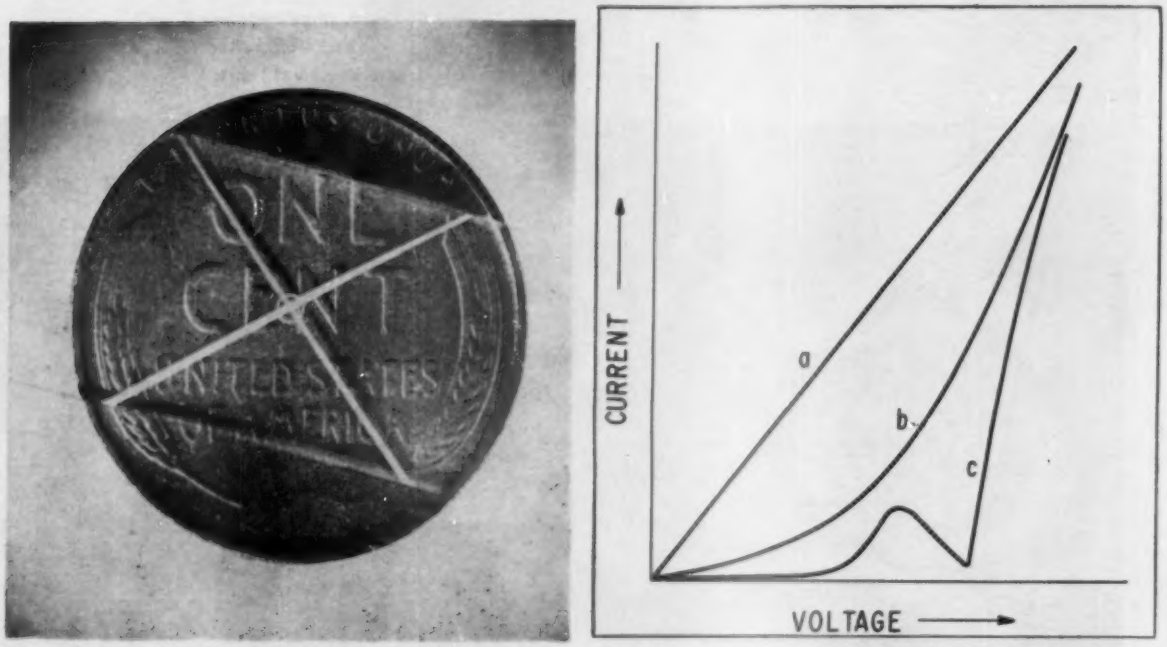

NEW ELECTRONIC device using recently discovered principle may be the forerunner of an entirely new family of devices. Experimental unit shown at left consists of two metal films separated by ultra-thin oxide film insulator, deposited on a glass substrate. General Electric discovered that tunnel currents that flow through the insulator can be modified and controlled by using superconductive metal films. Dotted circle encloses device's working area. Chart at right shows current-voltage characteristics for tunneling through ultra-thin film insulator using two metal films of superconductive material; (a) shows tunneling current when two metal films are in non-superconductive state. Next curve (b) shows current when one metal is superconductive and one is not; (c) shows familiar tunnel diode negative resistance region when both metal films are cooled to superconductivity.

Tunnel Effect Found in Thin Metal Films

By Philip J. Klass

New York—Discovery by General Electric that the tunnel effect found in semiconductors also occurs in certain combinations of thin metal and insulator films when subjected to near-absolute-zero temperatures, may lead to an entirely new family of electronic devices.

Present knowledge of the new phenomenon suggests that a single basic device, produced inexpensively by deposition of thin metal films of near-microscopic dimensions, could provide a variety of circuit functions, including resistor, capacitor, switch, diode, negative-resistance diode and triode.

If subsequent events justify present optimism, the new technique might have nearly as great an impact on electronic technology as the development of the transistor. The need to operate the devices at near-absolute-zero temperatures may limit their use somewhat. GE emphasizes that such devices are not just around the corner, except for research models.

Ordinarily when two metal plates are separated by an insulating material, as in a capacitor, no current will flow between the plates when a d.c. voltage is applied across them. This holds true even when the insulator thickness is as small as 0.0001 in., GE points out.

However, if the insulator thickness is slashed to about one ten-millionth of an inch, current will flow as a result of what is called the tunneling effect. The magnitude of the current is proportional to the applied voltage, as in a conventional resistor (curve "a" in above sketch).

If thin metal films, fabricated from two different superconductive materials, are used as the plates and separated by an ultra-thin insulator, then another phenomenon occurs when one or both metal films are cooled sufficiently to become superconducting.

Ivar Giaever of GE's Research Laboratory found that when one metal film is cooled to superconductivity, but the other is not, the amount of tunneling current is greatly reduced at low applied voltages, but builds up rapidly as voltage is increased (curve "b").

When temperature is dropped further so that both metal films become superconductive, the tunneling current initially is extremely low, increasing with applied voltage. Then, like the familiar tunnel diode, it enters the negative resistance region where current falls off despite increasing voltage. Finally the current reverses again and rises sharply with increasing applied voltage (curve "c").

The foregoing suggests that a single device can exhibit three different types of characteristics, depending upon whether both of its metal film plates are superconductive, non-superconductive or in opposite states. Because a magnetic field can cause a metal in the superconductive state to return to its normal state, it appears that a triode device can be made in which the signal to be amplified controls the strength of the magnetic field applied to the metal films, causing the tunneling current to be modulated by the applied signal.

Unlike the tunnel diode, the negative resistance effect is independent of the direction in which the current flows through the device. The negative resistance region can be changed by

Engineer inspects Styroflex® cable installed on an antenna array at one of Pacific Scatter Communication System stations shown at right.

Over 40 miles of *Styroflex® Coaxial Cable* help assure

More than 200,000 feet of Styroflex® coaxial cables are in active use as balanced antenna feed lines in the recently completed Pacific Scatter Communication System stretching from the Hawaiian Islands to Okinawa. This trans-Pacific system, one of the largest and most advanced of its kind in the world, uses ionospheric and tropospheric propagation techniques that produce over 99% reliability. An important part of the Strategic Army Communications Network (STARCOM), the system was designed, developed and constructed by Page Communications Engineers, Inc. for the U. S. Army Signal Corps.

Each of the nine stations in the network is equipped with the same major component parts—transmitters, exciters, multiplex terminals and antennas. The cables used in the 200- and 400-foot antenna arrays range from ⅞" jacketed Styroflex® cable to 3⅛" jacketed Styroflex® cable. About 7,000 feet of ½" jacketed Foamflex® cable is also used in the system. The Styroflex® cables were spliced in the field by an inert-gas Heliarc welding process to assure noise-free connections required for successful duplexed antenna operation.

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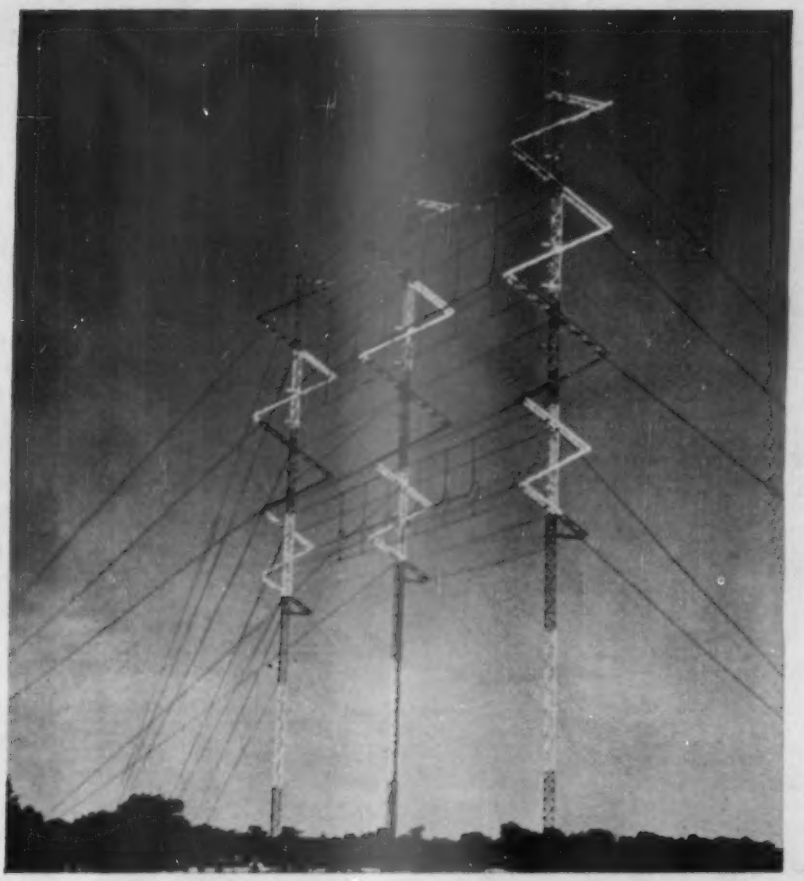

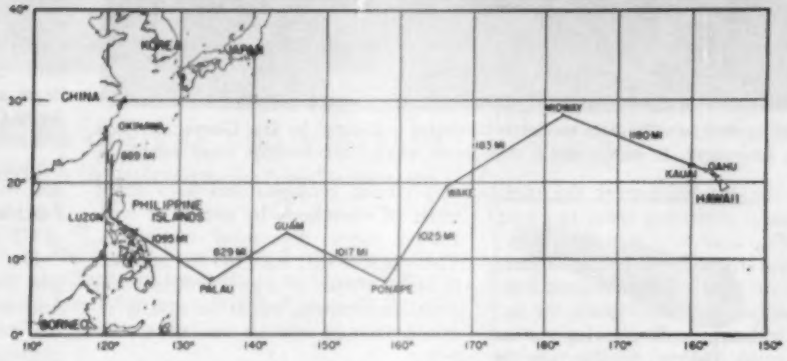

Pacific Scatter Communication System reliability!

dielectric cable's stable electrical and mechanical properties—especially qualify it for the critical specifications of this STARCOM system. If your system requirements call for a cable with low loss and high reliability, investigate the successful record of Styroflex®!

(Photos courtesy of Page Communications Engineers, Inc.)

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VOLTAGE applied to a thin-film experimental device is adjusted by Ivar Giaever, of GE's Research Laboratory. In background is recorder on which current-voltage curve was traced.

varying the temperature of the metal films and/or subjecting them to a magnetic field, Giaever points out.

Because the current-voltage characteristics are greatly different from those of transistors or vacuum tubes, the new devices will require the development of new circuitry tailored to the new device.

The same was true of transistors with respect to vacuum tube circuits.

General Electric has conducted experiments using films of aluminum, lead, indium and tin, all of which become superconductive at temperatures near those of liquid helium. A sizable number of other metals are expected to exhibit the same effect.

Aluminum oxide has served as the insulator in most of the experiments, but GE tests indicate that tunneling occurs in tantalum, niobium and nickel oxides.

An attractive feature of the new technique is that it uses thin films which can be fabricated in large complex circuit configurations in a single series of operations by means of well-known vapor deposition techniques. This suggests that both the size and cost of certain types of equipment, such as digital computers, might be greatly reduced through use of the new technique.

Tunneling Theory

The theory of tunneling used to explain the phenomenon as found in semiconductors has not proven adequate to explain the phenomenon in metals, GE says. Nor is the basic mechanism responsible for superconductivity fully understood. It is, therefore, not surprising that scientists have some difficulty in explaining the effect produced by the combination of the two.

Present knowledge indicates that the tunneling effect is best explained by considering electrons as waves rather than particles. These electron waves travel through metals (conductors), but when they encounter an insulator they are reflected after penetrating a short distance into the insulator. If the insulator is thick, the electron wave is attenuated to zero inside the insulator, but if the insulator is extremely thin, a portion of the wave can penetrate through it and emerge from the other side.

This small fraction of electrons that pass through is said to "tunnel" through. The thinner the insulator, the larger the fraction of tunnel electrons (current) that pass through.

The fact that certain metals at extremely low temperature become nearly perfect (loss-less) electrical conductors, and tend to resist penetration by magnetic fields providing the latter do not exceed a critical strength, has been known for some time.

Another, less well-known property is that metals in a super-conducting state will reflect electron waves whose energy levels lie in a narrow range called the "energy gap."

This means that any electrons in one metal film which have energies equal to the "forbidden" energy levels in the other metal film will not be able to tunnel through the intervening insulator. The particular forbidden energy gaps that exist in the metals used have a significant effect on the tunneling currents that can pass through the insulator. It was this effect that Giaever discovered in the course of his experiments.

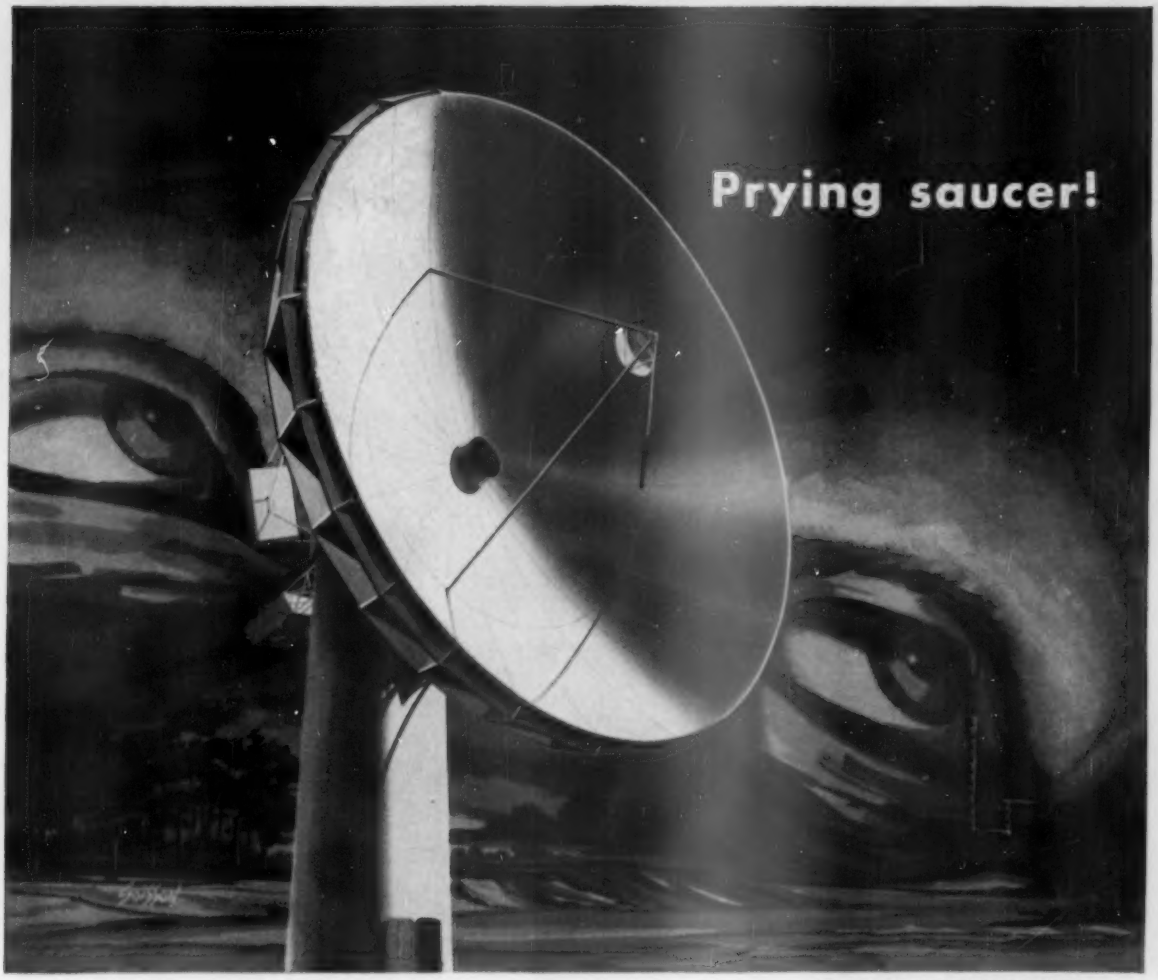
If superconductivity is destroyed, by raising the temperature or by application of a sufficiently strong magnetic field, the forbidden energy gap disappears and tunneling currents can then flow. Or the electron waves can be given increased energy, by applying a higher voltage across the plates, in order to permit tunneling currents to flow, according to Dr. John C. Fisher of GE's Research Laboratory.

Dr. Guy Suits, GE vice president and director of research, calls the new finding "an important scientific discovery" which is "so recent that all of its consequences can not be fully determined."

C-W Optical Maser Studied for Space

Dayton, Ohio—Sun-powered transmitter employing a continuous-wave optical maser will be the goal of an unusual program being initiated by USAF in an effort to establish the applicability of recently developed optical masers to space communications.

A contract expected to lead to the development of an experimental optical maser transmitter along with an appropriate antenna as an integral part of the



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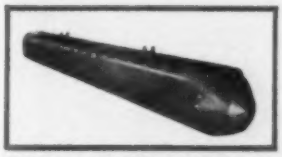
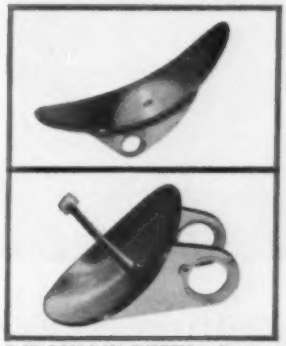


APS-94 ANTENNA SYSTEM included complete design of antenna for airborne side-looking radar.



B-58 BOM-NAV SYSTEM reflectors feature curvature tolerances of ±.005".

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If you are qualified for senior level work in this highly select staff, please send a brief resume to Mr. C. H. Lang, Director of Employment, The Martin Company, Orlando 22, Florida.

WORK IN THE CLIMATE OF ACHIEVEMENT

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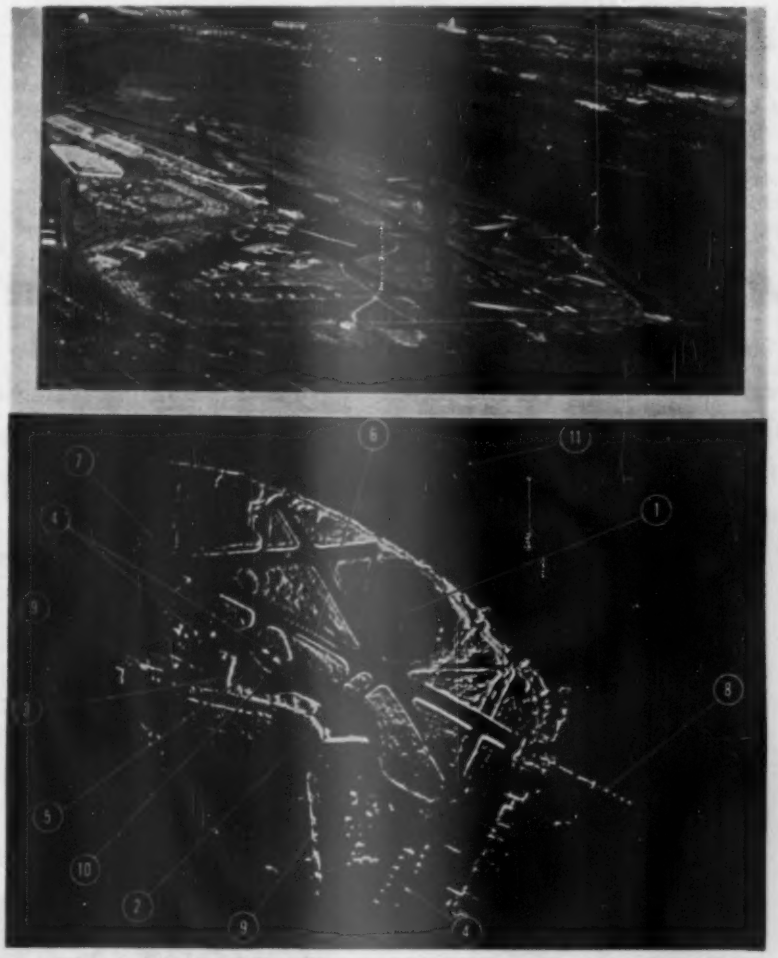
transmitter system will be awarded by the Air Force in mid-December, informed sources here indicated.

Eight companies attending a recent bidders' briefing held at Wright Air Development Division heard Air Force outline its requirements for the space communications system. The eight were Bell Telephone Laboratories, Electro-Optical Systems, General Electric, General Precision Laboratory of General Precision, Inc., Hughes Research Laboratories, ITT Laboratories, Raytheon and Technical Research Group.

Although technical people from several of these companies privately expressed doubt about the feasibility of meeting USAF requirements for the optical maser transmitter, most firms present at the briefing are believed to have subsequently submitted system proposals.

Essentially, Air Force desires a transmitter in which an optical maser will be both a source of continuous wave radiation and an amplifier. Power for the maser is to be supplied by the sun's energy and will be collected and concentrated by a lightweight mirror (collector) system of the type provided to WADD under a separate solar communication system contract (AW May 2, p. 164) by Electro-Optical Systems.

Optical masers operated by Hughes and Bell Telephone Laboratories (AW Oct. 24, p. 75) employ flash tubes as power sources and provide pulsed output. Required radiated power density for the USAF-desired device along its axis of symmetry is to be greater than



Taxi Radar Outlines Washington National

Taxi radar view of Washington National Airport, as seen by newly installed Airport Surface Detection Radar, the third of 10 scheduled installations at major airports, shows extremely high resolution of the equipment produced by Airborne Instruments Laboratory. Radar scope photo below aerial view of Washington airport, shows (1) control tower, (2) main terminal buildings, (3) north terminal building, (4) parked aircraft, (5) tracks of aircraft taxiing to parking ramp, (6) tracks of aircraft landing on main runway, (7) runway lights, (8) approach lights, (9) hangers, (10) tracks of moving fuel truck and (11) navigation buoy in Potomac. Radar was developed for Federal Aviation Agency and Air Force.

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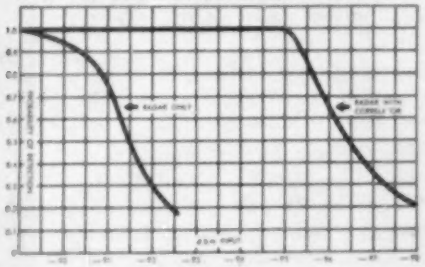
This new Video Correlator is now available as a plug-in unit for fire-control and search radars both airborne and ground-based. Flight and laboratory tests have proved that this compact, 0.3 cubic foot radar augmentation device: • makes target detection certain • serves as an effective counter-countermeasure • reduces interference from other radars • eliminates external and self-generated radar noise. Vought Electronics designed the unit for easy back-fitting into existing systems. It contains its own power supply and requires only a simple rigid mounting somewhere in the aircraft.

HERE'S HOW VOUGHT ELECTRONICS' VIDEO CORRELATOR INCREASES THE PROBABILITY OF DETECTION WITH ONE EXISTING FIRE-CONTROL RADAR . . . . .



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that obtainable by direct reflection of sunlight energy.

Should the sun-powered transmitter prove feasible, it will more than vindicate the beliefs of optical maser proponents (AW Dec. 14, p. 87) who have boosted the device's unusual characteristics for space communications and radar. For such purposes, they point out, optical maser systems would be highly directional, jam-free, capable of transmission over immense distances, and possibly require little power. Use of the sun as a power supply, or source of pump power, would additionally simplify and lessen the weight of the device.

Neither the output beamwidth nor the output frequency was specified in the USAF request. Input or pump frequency will lie in the solar spectrum (which includes infrared, ultraviolet and visible wavelengths), probably in the visible red like those of ruby optical masers already operated because this program will not underwrite maser development itself.

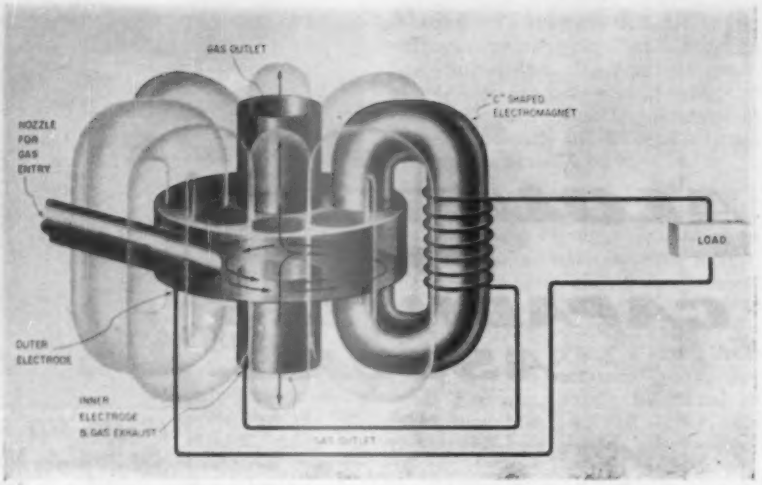
Several of the firms at the bidders' briefing, including Bell Laboratories, Hughes and Technical Research Group, are known to be looking at a variety of materials which could extend optical maser operation into infrared or ultraviolet regions. But it is not known whether the pump source spectral requirements for these materials are met in the solar spectrum.

The USAF sun-powered transmitter program will be divided into two phases. These are:

- **Phase I**—Study and investigation to determine proper approach and correct techniques needed for the sun-powered optical maser transmitter.
- **Phase II**—Design, fabrication and testing of the transmitter.

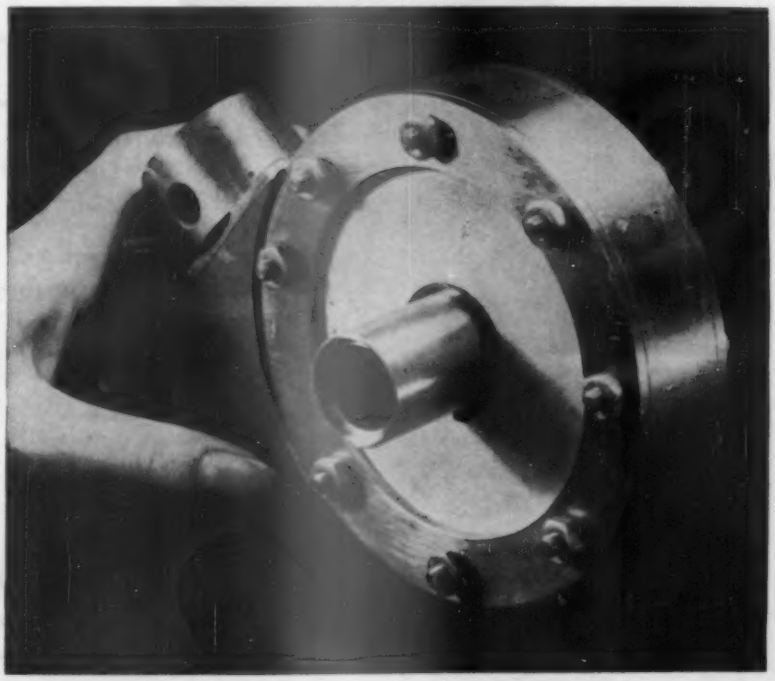
While modulation of the maser-generated optical carrier will be of concern, modulation techniques will not be stressed in the program. Output power density of the transmitter will be 10^7 watts per steradian when using a collector mirror of one square meter.

Present Air Force funding of optical maser development consists of a $\frac{1}{2}$-million follow-on contract from the Air Force Office of Scientific Research with Technical Research Group, Syosset, N. Y., a $70,000 WADD contract (AW July 18, p. 96) with Hughes Research Laboratories, Malibu, Calif., and a very small effort at Columbia University in New York. In addition, Electro-Optical Systems, Pasadena, Calif., is nearing completion of a near $\frac{1}{4}$-million one-year program for the development of a solar communications system using sunlight as the direct unmodulated carrier (AW Jan. 4, p. 15) and General Precision Laboratory holds a $78,000 Rome Air Development Center award (AW Mar. 14, p. 23) for investigation of communications techniques in wave-

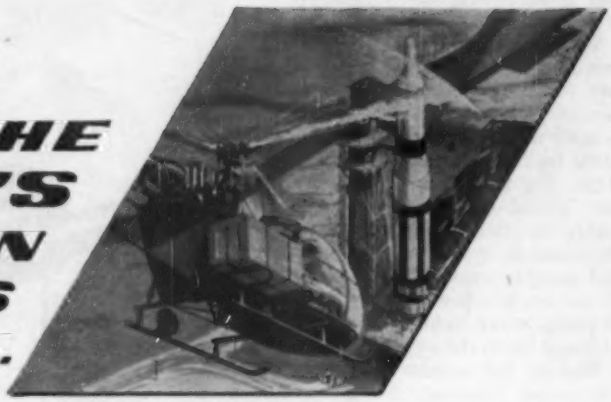


Magnetohydrodynamic Power Generator Developed

Unusual magnetohydrodynamic power generator developed by Thompson Ramo Wooldridge will be further investigated under a new contract awarded the company by National Aeronautics and Space Administration. Designed to operate over a wide range of power levels from a few kilowatts on up, the device is called a vortex magnetohydrodynamic power generator. Possible applications for the unit, as foreseen by the company, include its use in a manned space vehicle as a source of emergency power, as an intermediate duration (one to two weeks) power source, and as a source of short repetitive bursts at extremely high power outputs. As in earlier magnetohydrodynamic power generators such as the one developed by General Electric's Aerosciences Laboratory last year, the Thompson Ramo Wooldridge unit depends upon the movement of a hot plasma across a magnetic field to induce an electromotive force between two electrodes. In effect, the hot gas replaces the armature and turbine of a conventional gas generator. Unlike the earlier General Electric device, the Thompson Ramo Wooldridge vortex MHD power generator is designed so that the gas particles will traverse spiral paths in the magnetic field. This vortex flow pattern of the gas, according to TRW engineers, improves the utilization of the magnetic field, increasing the power output/weight ratio of the generator.



THE ALOUETTE'S PROVEN CAPABILITES ASSURE...



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lengths between infrared and ultraviolet. The latter study presupposes use of incoherent, exploded-wire light sources (AW Feb. 22, p. 62). Raytheon, Santa Barbara, Calif., is known to hold Signal Corps contracts for active infrared system development and Farrand Optical's optical radar (pulsar) has been government-funded. Other techniques for generation of coherent light are under study with Air Force funding.

FILTER CENTER

▶ **MicroMin Coming of Age**—First signs that military agencies are seeking microminiaturization for actual hardware rather than in research and development programs or feasibility models are cropping up. Several recent requests for proposals on new projects issued by Wright Air Development Division, Edwards AFB, Calif., and Office of Naval Research specify that microcircuitry be employed.

▶ **Semiconductor Evaporation**—Single crystal germanium is being reproducibly evaporated on single crystal dielectric substrates at Lear's Solid State Physics Laboratory as part of the company's microcircuitry program. Germanium dots can be accurately controlled to any thickness between 200 angstroms and one micron and can be precisely placed on the substrate. Crystal structure of the substrate is the same as that of the semiconductor and ultimately makes possible a truly epitaxially grown semiconductor device. In addition, dielectric properties of the substrate permit successful synthesis of passive film circuitry.

Infrared Relay

Weston Instruments Division of Daystrom, Inc., has developed an ultra-sensitive, directional infrared ray-operated relay for detecting temperature changes. Adjustable heat-sensing device, Model 5121, can be used at a distance from hot forming processes to actuate water sprays, take-up reels, pouring devices, furnace doors, conveyors. Unit requires no water cooling.

▶ **Helicopter Avionics**—Bell Helicopter will soon award a contract for design and construction of a function generator for use in a rotary wing vehicle as part of the Army Navy Instrumentation Program. Norden and General Electric are among the bidders.

▶ **Microminiaturization Rewards**—Micro component suppliers are starting to feel the financial rewards of the mounting belief among circuit design engineers that for the next few years at least individual, discrete micro components will be gaining a strong footing in the avionics/space technology field. The more exotic functional or molectronic circuits, this belief continues, still have hurdles to surmount. More and more attention by both component manufacturers and systems makers is being devoted to determining and improving reliability of new micro components.

▶ **Films Resist Radiation**—Thin films, less than five microns in thickness, appear to have resisted heavy doses of steady-state radiation in recent tests conducted by scientists at the Franklin Institute. These tests tend to confirm belief of thin film specialists that small cross-sectional area would enable the films to be superior to other avionic

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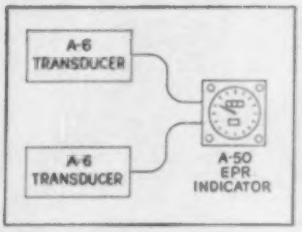

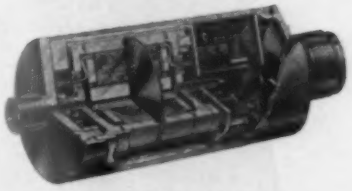

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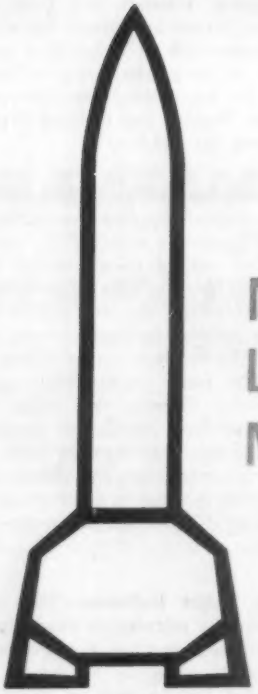

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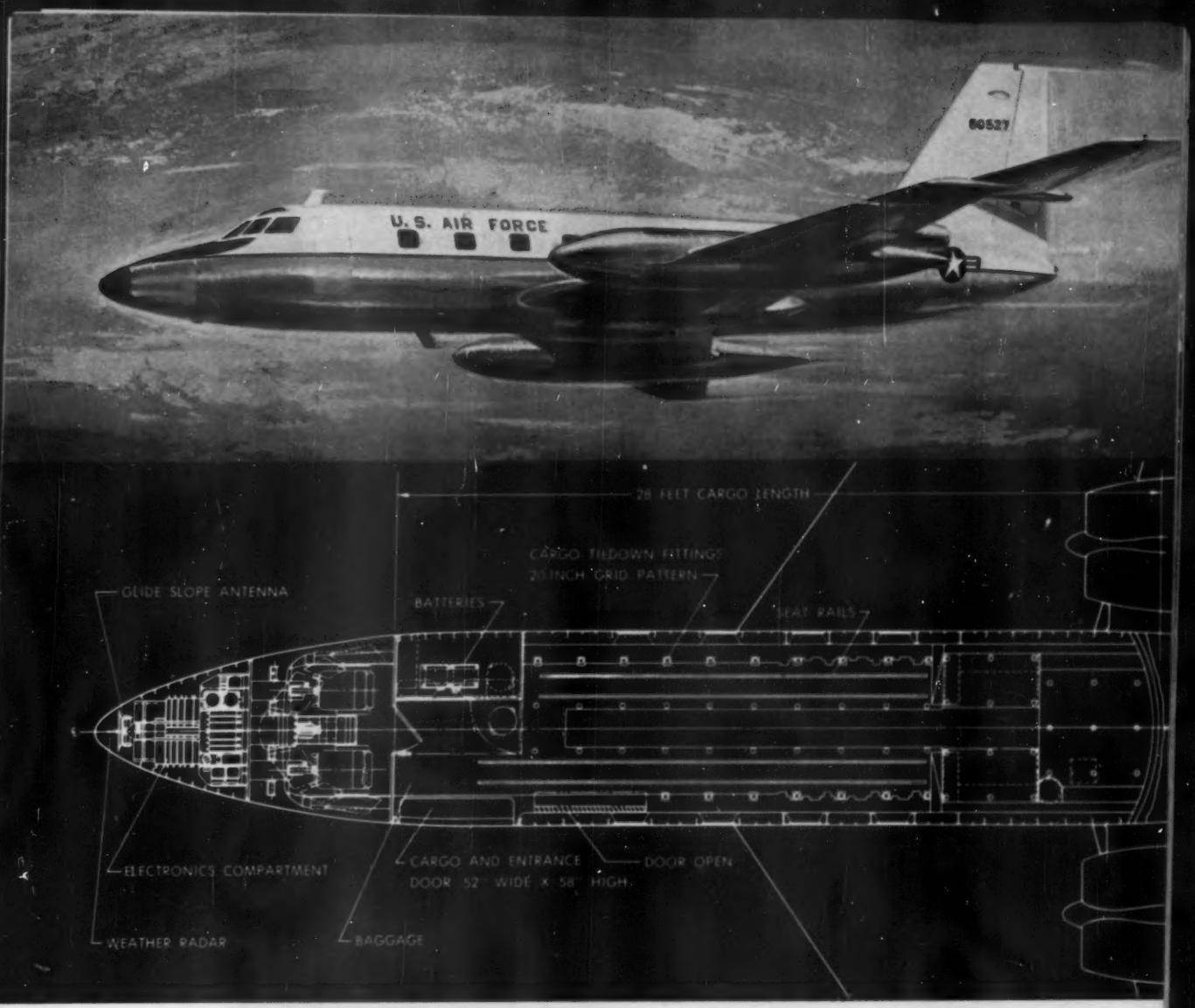

UTILIZATION

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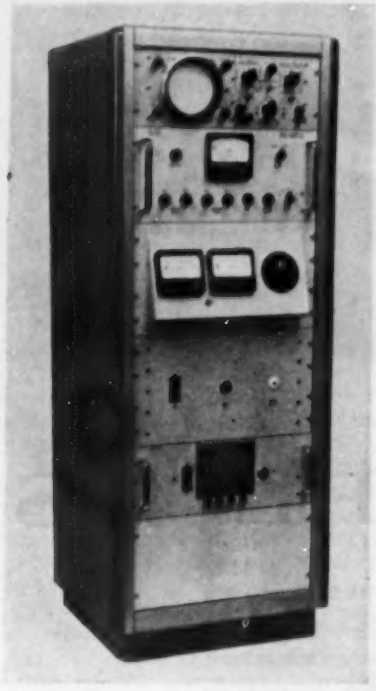
components in radiation environments. Such findings could have an important bearing on the design of avionic equipment for space projects, especially some long-life later generation earth satellites which will be exposed to appreciable total radiation dosages over long periods in the Van Allen belts. Thin films have been regarded as promising for avionic/space applications because of their light weight, small size, low power requirements and ultimate reliability.

NEW AVIONIC PRODUCTS

• **B/H Meter,** Model 651B, graphically displays the hysteresis loop of tape or pigment on an oscilloscope. Direct reading calibrated range of sample flux is from 3 to 1,000 maxwells with a maximum sample chamber diameter of



¾ in. The meter can measure coercive force and remanence or flux at an arbitrary point. Meters can be purchased at $6,000 each on a 45 day delivery basis. Manufacturer: Scientific-Atlanta, Inc., 2162 Piedmont Rd., N.E., Atlanta, Ga.

• **X-band voltage tunable magnetron,** Type Z-5429, provides minimum of 1 milliwatt CW power frequency range of 8.5 to 11 kmc. Tuning rate is 9 mc. per volt. Maximum anode voltage is 2,000 v. The complete RF package weighs 4 lb. and can be conduction or air-cooled at 5 cu. ft./min. for operating at ambient temperatures up to 50C. Sample quantity price is $1,300. Manufacturer: General Electric Co., Power Tube Dept., Schenectady, N. Y.

• **Spring-driven rate gyro,** Model RG14, reaches operating speed within 100 milliseconds after solenoid-actuated release mechanism is operated. Intended for use in expendable drones and missiles, gyro operates over temperature range of 0 to 55C, up to 25,000 ft. altitude and reportedly meets MIL-E-5272 vibration requirements. Gyro weighs 15 oz. Manufacturer: Humphrey, Inc., 2805 Canon St., San Diego 6, Calif.

• **Electrostatic linear voltmeter,** Model 1170, capable of measuring d.c. voltages in the 0-10 v. range or as high as 0-50,000 v., has an input resistance of 10^{10} ohms minimum and draws no current. Accuracy is within 2%, stability is better than 2% in 24 hr. at ambient temperature, and repeatability is

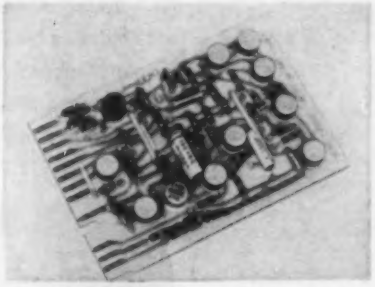
quoted at 1%. Instrument can be used to read capacitor voltage without discharge or peak value of transient pulses, among other applications. Manufacturer: B. K. Sweeney Manufacturing Co., 6400 East 44th Ave., Denver 16, Colo.

• **Altitude control transducer,** Model 5468, designed for altitude control applications where its small size, ruggedness, low threshold and high sensitivity are desired. Sensitivity is 4 mv. ±5% per ft., threshold is 4 ft. at 60,000 ft. Over-all dimensions are 3.25 x 4.35 in. Transducer provides a.c. output; operates from −54 to 120C and is suitable for use in aircraft autopilot systems, fire control and drone guidance units. Manufacturer: Giannini Controls Corp., 1600 S. Mountain Ave., Durate, Calif.

• **Turret RF attenuator,** Model TAB-50, provides zero to 59 db. attenuation in one-db. steps at frequencies ranging from d.c. to 1,250 mc. Two knobs permit setting of attenuation in decade and unit values with total attenuation read out as a two-digit number. Accuracy is quoted at 0.2 db. at 200 mc., 0.5 db. at 900 mc. in the 0-10 db.

range. Above 10 db., accuracy is 2% plus/minus 0.2 db. up to 200 mc. and 5% plus/minus 0.3 db. at 900 mc. Insertion loss is 0.1 db. up to 300 mc., 0.4 db. at 900 mc. Power rating is one watt. Price is $225 in single-lot quantities. Manufacturer: Telonic Industries, Inc., Beech Grove, Ind.

• **Solid-state operational amplifier,** Model 3801, provides high gain, wide bandwidth and chopper stabilization. Total d.c. gain is greater than 250,000; frequency response from d.c. to 200 kc. Input drift is 1 mv./30C change, out-



put is ±10 volts at 4 mils load current, ±20 volts at 2 mils. Amplifier measures 3¾ in. long, 2¼ in. high, ½ in. thick. Price is $400 and delivery can be expected in 45 days. Manufacturer: Donner Scientific Co., 888 Galindo St., Concord, Calif.

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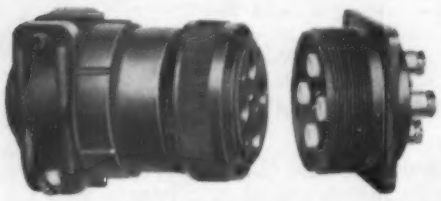

CANNON PLUGS

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FINANCIAL

Martin Proposes Stock Split

Martin Co. stockholders will be asked to approve Jan. 9 an increase in authorized capital stock from 6,000,000 to 12,000,000 shares to provide for a 2-for-1 stock split and for future acquisitions.

Until now, Martin's acquisitions have been on a cash basis. Initially Martin began buying stock of General Precision Equipment Corp., but its suggestion of a candidate for the GPE board was not acted on.

Since then, Martin has not been openly acquiring any GPE blocks, but it has been buying heavily into Nuclear Corp. of America. It exercised options in September to buy 85,690 shares to bring its holdings to 773,166 shares. Martin was instrumental in the selection of David A. Thomas, former Radio Corp. of America vice president, as Nuclear Corp. chairman. Chairman George Bunker of Martin also is a Nuclear Corp. board member, and so are two other Martin directors.

Martin owned 18% of Nuclear's stock prior to exercise of warrants and may soon have formal control of the company if it does not have effective control already. Bear Stearns & Co., a New York investment house that underwrote a bond issue for Martin two years ago, also exercised options a month prior to Martin to bring its holdings to 600,020 shares.

Nuclear Corp. has technical talent of interest to Martin and is doing work in rare earth and high voltage electronic tube areas that might be useful to Martin's nuclear operations.

Martin directors also approved a quarterly cash dividend increase from 40 to 50 cents a share on shares now outstanding. Stockholders do not have to approve the stock split itself, but the increase is necessary to provide enough shares. Martin now has 3,077,647 shares outstanding.

Northrop Stresses System Management

New York—System management capability is as important today to the subsystem contractor as it once was to the prime contractor, Thomas V. Jones, president of the Northrop Corp., believes.

"It is essential in today's environment," he told the New York Society of Security Analysts, "that a company have the flexibility to deliver either a total system capability or the capacity to handle with the same skill any segment of a system. By the same token, a company which acts as a system manager must be able to manage and incorporate into the system those separable technologies which may not be under its own direct corporate control."

Technological complexity has produced, even in manufacturing, greater division of fundamental responsibility. Missile system components, for example —re-entry vehicle, guidance, propulsion —are major subsystems that require a full measure of system management capability.

In the past, Jones said, technical skills were largely intermingled and assigned to a single end product as contracts were received. Today Northrop views technical areas as separate fields to be managed, developed and exploited as a source of business beyond the immediate project at hand. The company is organized around fundamental technical capabilities, he said, not projects. Northrop's diversification moves have been aimed at strengthening individual technical areas and by such diversification the company hopes to reduce the feast-or-famine cycle often experienced in the aviation industry.

With the growth of technology, Jones added, has come a corresponding growth in costs and Northrop has established a system of introducing cost at the earliest stage in the formulation of a concept. It takes the most sophisticated ingenuity to find the simplest solution, Jones said, but the company that can provide the desired solutions to defense or space problems at a reasonable cost will win business.

One way Northrop seeks this capability is by indoctrinating technical people with the requirements of business and non-technical people with knowledge of technology, Jones said.

Northrop has put a segment of its cost control program to use by making its Norair Division Performance and Cost Evaluation (PACE) program available to other companies on a fee basis.

Financial Briefs

Some initial post-election optimism in Wall Street about aerospace stocks is cooling off. Analysts now are beginning to sit back and wait to be shown before recommending industry stocks on the assumption the new administration will automatically order drastic increases in defense spending.

Thermo Electron Corp., Cambridge, Mass., has announced new financing arrangements which will provide about $1 million for expansion in the next 12 to 18 months. Financing, which included both stock purchases and convertible debentures, was with a group consisting of Laurance S. Rockefeller, James Brady, New York investor, Lehman Bros., investment brokers, and Peter M. Nomikos, a company founder. Thermo Electron's interest is in research and development and manufacture of direct energy conversion devices.

Bowmar Instrument Corp., Ft. Wayne, Ind., reported earnings of $323,664 on sales of $5,411,822 for the year ended Sept. 30. This compares with earnings of $201,220 on sales of $3,344,482 for the previous year.

Menasco Manufacturing Co., Burbank, Calif., specialists in aircraft landing gear, hydraulic systems and pressure vessels, has acquired Micro Gee Products, Inc., Culver City, Calif., manufacturer of power amplifiers, pressure controls and electro-mechanical flight simulation tables for testing gyros. Micro Gee was formerly a subsidiary of Lerco Electronics, Inc. Last year, Menasco acquired Security Valve Co., South Pasadena, Calif., manufacturer of automatic control valves.

Litton Industries, Beverly Hills, Calif., earnings for the Fiscal 1961 first quarter ended Oct. 31 totaled $2,150,000 compared with $1,537,000 for the same quarter last year. Sales in the first quarter were $52,111,000, an increase of $15,676,000 over the $36,435,000 in the first quarter of Fiscal 1960.

The Marquardt Corp. reported sales of $51,139,377 and earnings of $1,088,203 for the 40-week period ending Oct. 9. Sales and earnings for the same period in 1959 were $50,534,557 and $1,309,606.

Robinson Technical Products, Inc., has a gross income on sales and services of $11,679,791 for the fiscal year ended June 30, 1960, compared with $3,501,440 for 1959. Net earnings rose from $320,566 in 1959 to $567,704 this year.

Electronic Engineering Co. of California showed a net income of $150,000 for the first nine months of 1960 on sales of $3,294,000. Sales for the first three quarters of 1959 were $3,124,835. Earnings for this period in 1959 were $158,000.

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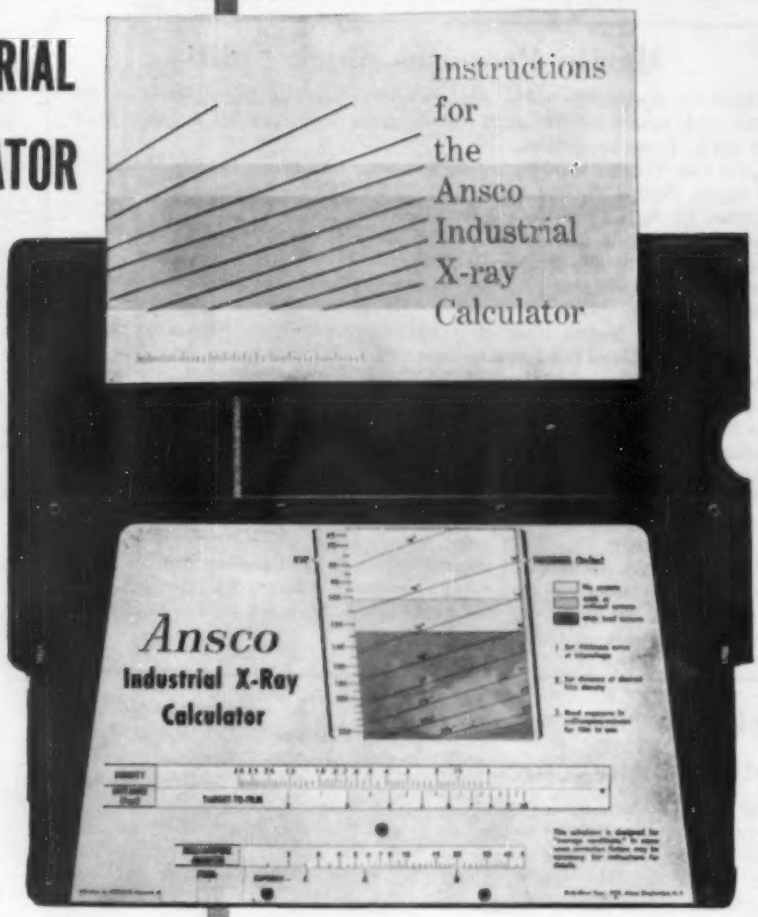

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TWIN BONANZA for 1961 has redesigned nose for weather radar adaptation; new window has been added at aft cabin section.

Beech Pegs 1961 Sales at $77 Million

By Erwin J. Bulban

Wichita, Kan.—Business aircraft sales target of more than $77 million, deemed as a "very reasonable objective . . . that should be easier to reach than was the goal in 1960," was set before Beech Aircraft Corp.'s domestic and international distributor and dealer organization here during a preview of the 1961 model lineup.

Sales group last year topped the programed "$60 million in '60" by $2,450,000. Some $52 million of the total was in domestic sales and approximately $10 million was export volume.

Percentage increase in Beech business aircraft sales last year over 1959 was "much more than we had been accustomed to doing," Wyman Henry, vice president-marketing, told distributors and dealers, adding that "in a growing market that we now enjoy, it was a good job, but it wasn't outstanding."

Domestically, the company's volume increased 23%. It was vice president Michael G. Neuberger's export sales team that really set the new records—a 108% increase in business. The German distributor alone, Travelair GmbH., disposed of nine Queen Airs and had two more on order in that country. Export backlog is $1 million, up 50% from last year.

Indications of how Beech proposes to get its percentages still higher were evi-

BONANZA N35 has larger rear windows for 13% increase in visibility; control system has been modified. Below is the Super G18, which now has new picture window added to cabin.

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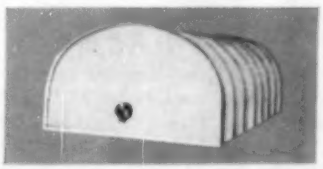

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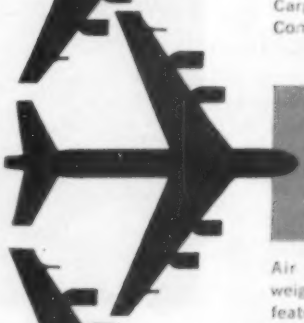

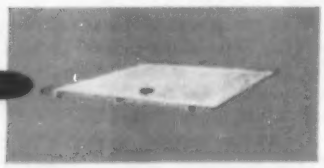

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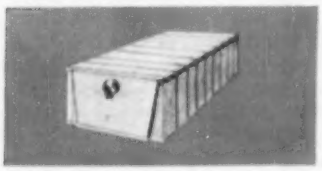

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dent during the sessions. Highlights are:

• **Showing of 1961 line,** now numbering eight airplanes, with addition of the new light-twin, five-seat Model 55 Baron (AW Nov. 21, p. 31).

• **"Turn-key" facilities** package program for dealers that is aimed at easing the task of enlarging the sales organization. Company plans to add some 200 new dealers in the next three years.

• **Increased emphasis** at building parts and accessories business. Beech is only scratching the surface here and giving a "gold mine" in service business away to facilities without a franchise stake in the company, Henry noted.

Barometer of the projected business volume was Beech's $15.5 million backlog one week after the showing, for 20% of the 1961 sales goal.

These are immediate plans. But some indication of where the company is heading was given AVIATION WEEK by executive vice president Frank E. Hedrick, sketching out top management plans on near-future airplanes:

• **Turboprop engines** are the answer to the business aircraft industry's "need to get out of the 200-mph. box we have been in," he said, pointing out that horsepower changes in piston engines now are so small that hardly enough performance increase is gained to justify their increased cost. Plane manufacturers now need a big increase in power to provide gains in both payload and performance and the minor increases provided by current piston engines make possible slight increases in one or the other, but not in both of any consequence, he indicated.

• **Turboprop power** will free the designer and builder of these performance shackles and again bring business plane performance into the area close enough to high speeds which customers acquainted with jet transport travel will consider competitive, plus the smoothness of turbine power that the customer now is accepting as normal.

• **Developments** in current small turboprops indicate that the transition to these engines will be much less expensive than initially contemplated, in at least one important area, Hedrick said. It appears that it will be possible to operate these engines at "acceptable fuel and power efficiencies in the 10,000-ft.-altitude regime," he explained, which should immediately pay off in obviating a requirement for costly and weight-consuming cabin pressurization.

If it is unnecessary to tack on high cost of going to pressurized cabins, the initial cost of a turboprop airframe will come into a completely different area and airframe builders should be able to head into this market with much more confidence than they had earlier because lower costs will mean a larger possible market and lesser financial risk.

First type of turboprop to be built by Beech will be what is now called around the plant the "King Air"—a Queen Air with turbines. This airplane should start flying in late 1962 or 1963, according to present planning, Hedrick noted. To optimize the airframe to the new powerplant will require revision of the Queen Air design toward thinner wings and new tail.

Next type to be "turbinized" will be the Travel Air or Baron-class light twin, but the schedule on this is not given, though Hedrick said it will follow, rather than precede, the "King Air" class.

In the interim, Beech is studying the possibilities of making the most of the current development by the French Firm, SFERMA, with the Travel Air (AW Sept. 5, p. 112). SFERMA representatives scheduled were to visit Beech last week to discuss market potential of the turboprop-powered Travel Air conversion. Indications are that if sufficient customer interest develops, Beech would supply Travel Air airframes to SFERMA for installation of engines in France for supply to foreign customers. For this hemisphere, SFERMA would supply engines to Beech for installation on the Travel Air line in Wichita.

Such an arrangement would tend to minimize delivery delays to the customer, since special assembly lines probably would not have to be set up to handle this market; rather the engines would be applied to appropriate airframes already moving down the normal lines.

DEBONAIR has had a useful load increase of 75 lb. Rear seat has been widened and three paint schemes are offered this year. Model 33 is priced at $21,750, an increase of $1,270.

Beech 1961 Model Prices

Wichita, Kan.—Slight price increases, averaging some 4% mark Beech Aircraft Corp.'s 1961 line of eight single and twin engine business airplanes unveiled here at the company's annual distributors and dealers meeting.

Models shown and basic prices are:

- **Model 55 Baron, a new light twin added to the line this year, lists at $58,250.**
- **Model G18 Twin Beech retails for $132,300.**
- **Model 65 Queen Air sells for $126,000.**
- **Model J50 Twin-Bonanza lists for $100,000.**
- **Model D50E Twin-Bonanza will sell for $87,250.**
- **Model N35 Bonanza is priced at $26,500.**
- **Model A33 Debonair will cost $21,750.**
- **Model B95 Travel Air light twin, basically unchanged from last year, will maintain the same price as last year—$51,500.**

Beech business plane sales in Fiscal 1960 achieved an all-time company record of more than $46 million, representing a 22% increase over the previous high volume recorded in Fiscal 1959.

New Airplane

Hedrick also touched on Beech work in further broadening its line on the lower-cost end of the price scale, below the Debonair. A decision has been made that this airplane will be in the $10,000 price class. At least two factors have prompted this move, he indicated—initial belief that the next airplane would be in the $15,000 price range was changed because indications were that it would too quickly increase in price to the point where it would be competitive to the Debonair. Indicating how close Beech has come to the new class, Hedrick noted, "we have built some hardware," referring to the $15,000 price-class airplane. This apparently will be scrapped.

The other factor, which actually be-

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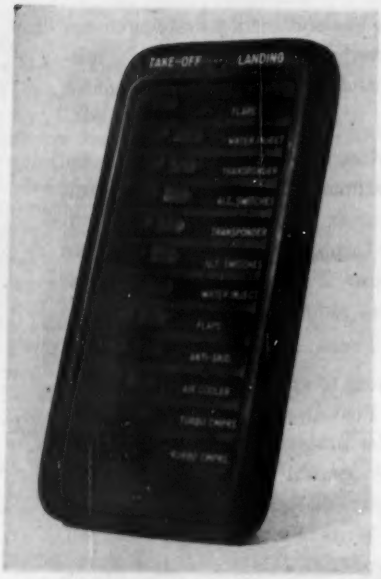

Check List Junior

Plasteck, Inc., Poteau, Okla., manufacturer of cockpit check lists for military and transport planes (above) has designed a Check List Junior for less sophisticated aircraft. Unit is illuminated by backlighting and buyer can specify his own check list items. Prices range from $24.95 for an eight-slot model, to $29.95 for 12-slots.

came apparent after the company had decided to drop the $15,000 project and concentrate the $10,000 type, was greater acceptance of the latter in foreign markets, where dollar shortages make sales of costlier airplanes difficult.

Beech apparently plans to exploit possibilities of having this airplane built abroad, in addition to producing it in Wichita. High-level sources say that the company will complete agreements, now open, with two countries as soon as the new airplane materializes.

New low-cost airplane will tie closely to Beech Aircraft's plans to greatly enlarge its dealer organization, since price will make it possible for a prospective dealer to start business in a new area where potential is not fully known, with a modest requirement for capital investment in demonstrators.

Product Line

To the dealer and distributor organization now on the books, these projects are far in the future—their immediate sales will come from the hardware displayed during the meeting here in Wichita. The 1961 line showed numerous improvements, aimed at answering requests from field sales staff members for changes. Indication that distributors and dealers feel that they will have a banner year is shown in an order backlog of $15,025,000 for 290 airplanes.

The expanded, eight-model 1961

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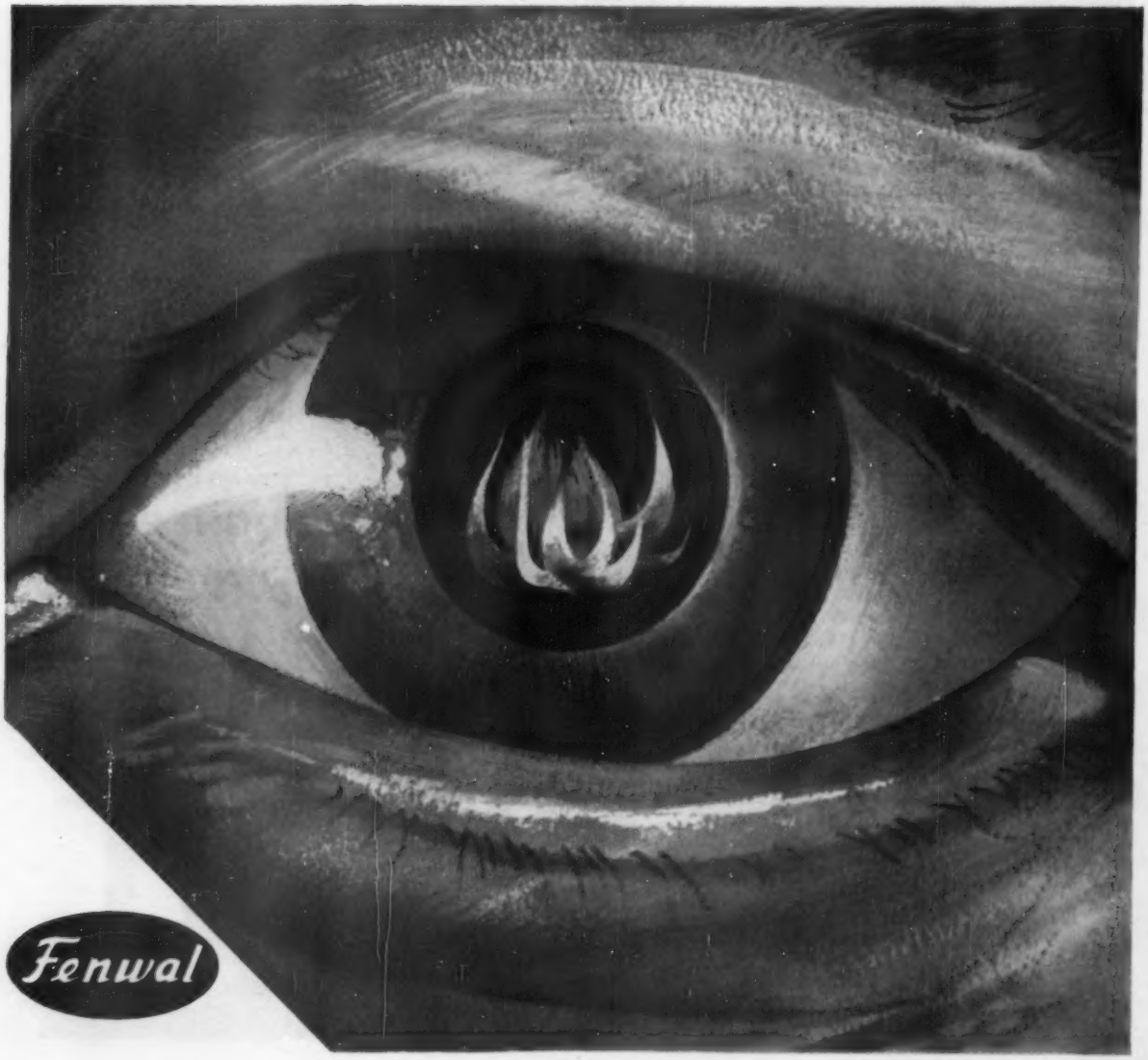


Fenwal

business plane line to be offered by Beech includes:

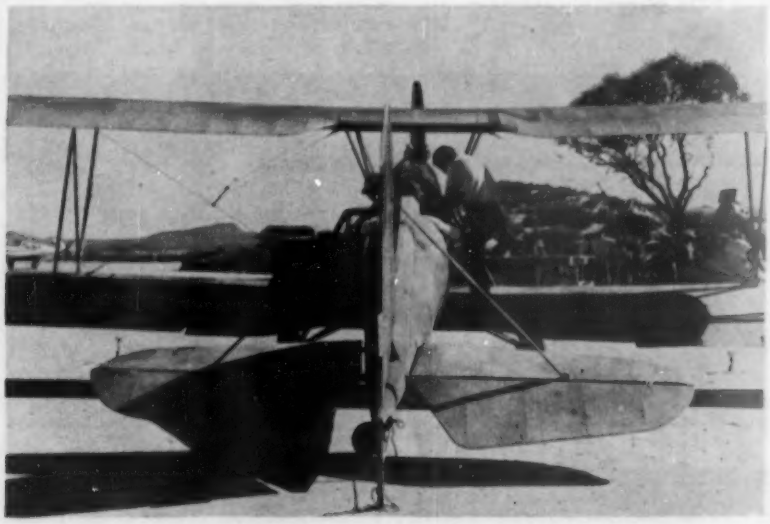
• **New Model 55 Baron,** a five-place light-twin, powered by two fuel injection 260-hp. Continental IO-470-L engines in low-drag nacelles. Price of the basic airplane is $58,250. Airplane can be leased for $1,184 per month, including liability and hull coverage: time-payment plan provides for installments of $1,219 per month, which includes hull insurance. Baron grosses out at 4,880 lb. and has a useful load of 1,920 lb. Fuselage provides some 143 cu. ft. of area for cabin and baggage compartments. One baggage compartment, in the nose, has 12 cu. ft. capacity, and there is a sideloading baggage station in the rear of the cabin for a total of 45 cu. ft. Standard fuel capacity is 112 gal.; 140-gal. capacity is available as optional equipment. Full gross weight twin engine rate of climb is said to be 1,630 fpm., while single-engine climb is given as 305 fpm. at 4,880 lb. gross. Service ceiling at gross weight is 19,200 ft.; single-engine ceiling, same weight, is 6,800 ft.

• **Travel Air B95** was not shown during the meeting, since the 1961 model will not be available until some time in March. Beech officials emphasized that this airplane is being continued in the line. Indications are that the price will stay at $51,500.

• **Debonair** four-placer, priced at $21,750, features a 75-lb. useful load increase, in addition to some 20 lb. of optional items now incorporated as standard, which accounts in part for the

Meyers OTW Used in New Motion Picture

Meyers Model OTW biplane trainer, first flown in 1939, is used as a wild horse herd scout plane in a new United Artists motion picture, "The Misfits," which was filmed in desert country near Reno, Nev. Plane, powered by a Kinner R-5 five-cylinder, 165 hp. engine, is flown by Col. Ken Slater (in cockpit) and is owned by Carl Olfers, Lovelock, Nev., a 72-year-old World War I pilot who still occasionally flies the airplane. The airplane was deliberately scuffed with sand to give it a "much-used" appearance. The OTW was developed by Meyers Aircraft Co., Tecumseh, Mich., which currently is resuming production of its Model 145 two-seat lightplane (AW Oct. 24, p. 110).



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For more information please write to Mr. A. M. Bowman, Engineering Personnel, North American Aviation, Inc., Los Angeles 45, California.

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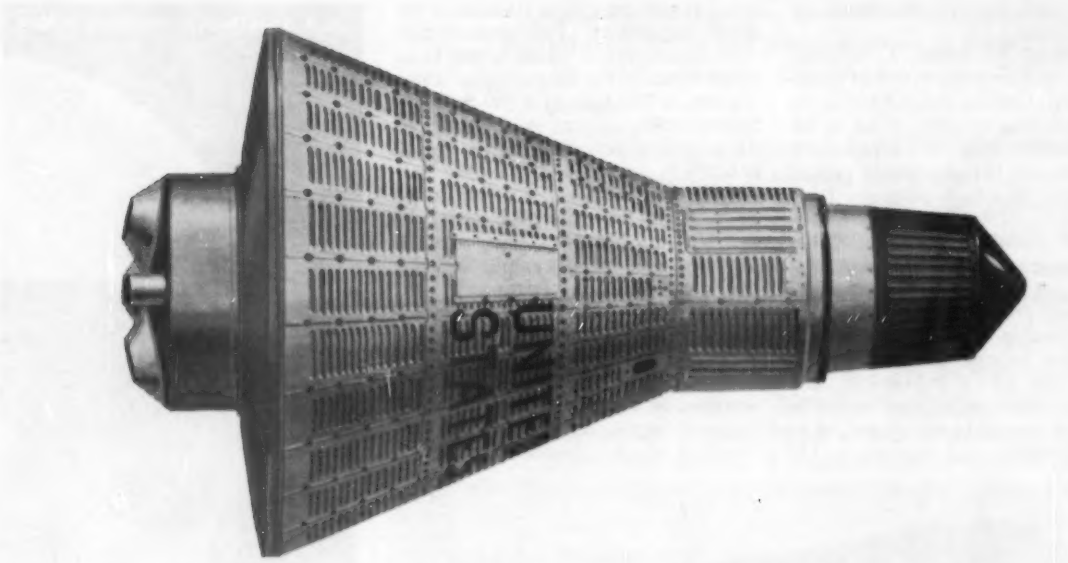

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Cubic Corporation has been selected by Bendix Corporation to furnish AGAVE automatic tracking antenna systems for the National Aeronautics & Space Administration's world-wide Project Mercury tracking and ground instrumentation network. These units will detect the manned capsule as it first comes over the horizon, lock on, and subsequently supply pointing information to radars, telemetry antennas and command transmitters.

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For more information on AGAVE, please write to Dept AW-6, Cubic Corporation, San Diego 11, Calif.

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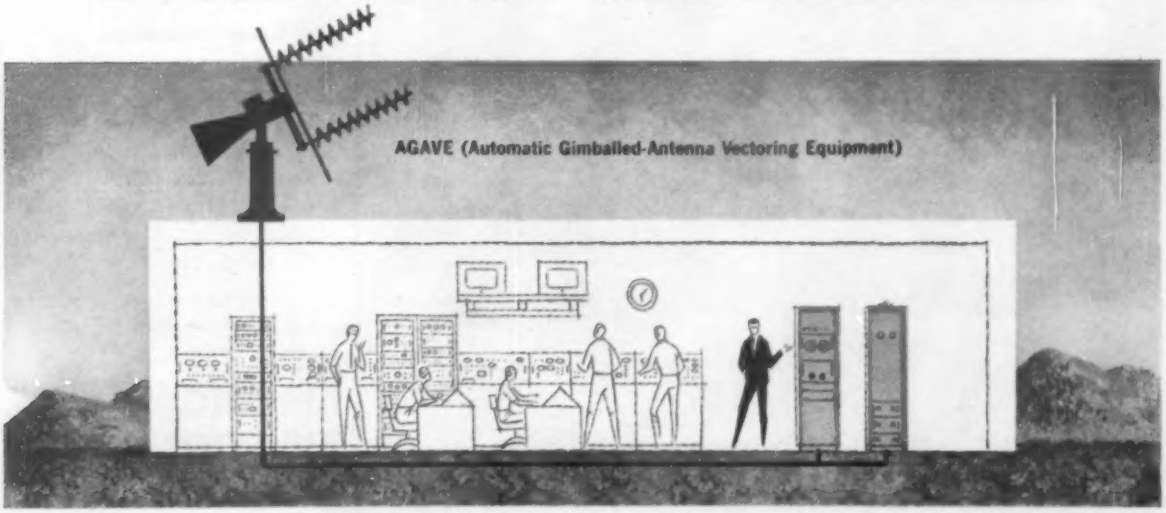

AGAVE (Automatic Gimballed-Antenna Vectoring Equipment)

price increase of some $1,270. Due to customer preference, 1961 Debonairs will leave the factory in choice of three paint schemes at standard price. New airplane has wider rear seat, overhead cabin air exhaust at rear of cabin, new fresh air inlet console in the roof, with five inlets, and sun visors. Beech, which formerly had estimated that there was a market of approximately $25 million in Debonairs, has revised this estimate up some $5 million.

• **Bonanza N35,** selling for $26,500 in its basic configuration, has an increase of 152 lb. useful load and now grosses at 3,125 lb. Larger rear windows give the N35 Bonanza a 13% increase in transparent cabin area for a total of 26 sq. ft. Front and rear seats this year are track-mounted. The rear seat has a movement of approximately 15 in.

Plane Modifications

Bonanza and Debonair this year have had a slight modification to the central system, with a bobweight incorporated in the cables between control wheel and floor, lessening elevator spring tension requirements and providing greater stability.

• **Twin-Bonanza** is continued in two models in 1961, the J50 with two supercharged fuel-injection 340-hp. Lycoming IGSO-480-A1B6 engines, priced at $100,000 in the basic model, and the D50E, powered by high-compression 295-hp. Lycoming GO-480-G2F6 powerplants, which will retail at $87,250 in the standard version. Revised instrument panel, conforming to Society of Automotive Engineers specifications for instrument placement in basic "T" configuration, also has been lowered and moved forward approximately 3 in. to increase cockpit roominess. Additional window panel has been added to the left side of cabin rear to improve passenger visibility.

• **Super G18 Twin Beech,** which is priced at $132,300 in the basic version, has been restyled and now features a picture window on each side of the cabin for improved passenger visibility. Indications are that among further improvements being studied by Beech for this airplane are fuel injection engines. However, officials say that they have not as yet found a system that satisfactorily meets factory requirements. Model 18, which now is in its 23rd continuous year of production, is a leading moneymaker for the company and last year some $15.5 million, in retail volume, was realized in Model 18 sales, termed the airplane's best year thus far. Last year saw deliveries of 96 units, 88 in the domestic market.

• **Model 65 Queen Air,** which sells for $126,000 in the basic model is similar to last year's version, with minor styling changes.

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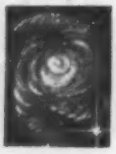

A Division of
GENERAL DYNAMICS

owned company finance organization, reported that during the past fiscal year, it did a total business of $17,893,988 in airplane financing, with 298 units valued at $11,631,465 floor-planned for distributors and dealers and 159 units handled on lease and on retail financing plans with a total volume of $6,262,523. Since inception of finance plans by BAC, the company has floor-planned 1,038 airplanes for a total dollar volume of $36,386,773 and has handled 565 retail contracts and leases for a dollar volume totaling $21,702,369, vice president-general manager A. R. Bell reported.

PRIVATE LINES

Piper Apache G has been selected for twin-engine training at new College of Air Training at Hamble, England. Nine aircraft have been ordered from Vigors Aviation, Ltd., Beech dealer at Oxford; first six will be delivered next June. College provides flight and ground training for students who will become pilots for British Overseas Airways Corp. Program involves six weeks of ground school, 150 hr. of single engine flight training in de Havilland Chipmunks, and 75 hr. in Apache Super Custom twins.

Aircraft Radio Corp., Boonton, N. J., has broadened its communications-navigation line to penetrate the multi- and single-engine business plane market. Line covers Starflite I, remote control equipment for multi-engine planes, and Starflite II, local control, panel-mounted comm-nav units for light twins and heavy single engine planes.

Cessna Aircraft Co. held its international export management conference Nov. 27-30 at Sao Paulo, Brazil, to outline marketing plans and show the 1961 line.

Finance plans covering modification of existing Beechcraft airplanes through modernization kits, factory-distributed accessories and exchange engines, have been developed by the Beech Aircraft Corp.

Piper deliveries in October totaled 89 aircraft with a factory net billing of $1,510,066. Included in shipments were 27 PA-18 Super Cubs; 11 PA-22 Tri-Pacers; three PA-23 Apaches; 12 PA-23 Aztecs; seven PA-24 Comanche 180s; five PA-25 Pawnees, and seven Aztecs to U. S. Navy.

All-metal Mooney Mark 21 four-place business plane, an improved Mark 20 with all-metal wings, will be announced by Mooney Aircraft, Inc., in mid-December.

WHO'S WHERE

(Continued from page 23)

Honors and Elections

E. H. Fitch of B. F. Goodrich Aviation Products, has been elected president of the Aviation Distributors and Manufacturers Assn., succeeding Paul A. Kennedy of Southwest Airmotive Co. Elected ADMA vice presidents: **George R. Galipeau**, Van Dusen Aircraft Supplies, Inc., and H. Webster Crum, Lycoming Division of Avco Corp.

Dr. Peter C. Goldmark, president and director of research for CBS Laboratories, has been awarded the Vladimir K. Zworykin Television Prize by the Institute of Radio Engineers for "important contributions to the development and utilization of electronic television in military reconnaissance and in medical education."

Changes

A. M. Scott, manager-sales and service, Aero Engineering, Rolls-Royce of Canada, Ltd., Montreal, Canada. Mr. Scott continues as chief engineer.

Raymond A. Rugge, director of engineering, Kollsman Instrument Corp., Elmhurst.

Charles S. Hazard, manufacturing specialist, American Machine & Foundry Co.

Richard L. Stone, manager-sales, General Electric's Special Programs Section, Defense Systems Department, Radnor, Pa.

Dr. Ralph P. Ruth has been appointed a senior scientist at the Hoffman Science Center, Santa Barbara, Calif., of Hoffman Electronics Corp.

J. Patrick Murphy, general sales manager, General Aircraft Supply Corp., Detroit, Mich., a subsidiary of Airwork Corp.

Lindsey M. Hobbs, manager of central research, Lord Manufacturing Co., Erie.

Ray J. Raupp, chief engineer, Bendix Filter Division, The Bendix Corp., Madison Heights, Mich.

Joseph Havrylak, director of Midas programs, Aerojet-General Corp.'s Avionics Division, Azusa, Calif.

Maj. Gen. Raymond C. Maude (USAF, ret.), director of field operations, Philco Corp.'s Government and Industrial Group, Philadelphia, Pa.

Harry R. Gillespie, assistant general manager, Trimpot Division of Bourns, Inc., Riverside, Calif., and **R. C. Archer**, director of sales. Also: **H. D. Wallis**, manufacturing manager-Riverside plant.

William S. Carley, project director, Research and Engineering Department, Jansky & Bailey, Washington, D. C., a division of Atlantic Research Corp.

Douglas Aircraft Co., Inc., has appointed **C. C. Martin** United Kingdom representative-defense programs, with offices in London, England.

G. Gordon Prentice, contract administrator-space programs, Convair (Astronautics) Division of General Dynamics Corp., San Diego, Calif.

Dr. E. R. Roberts and **J. B. Cowen**, assistant managers, Solid Rocket Plant, Aerojet-General Corp., Sacramento, Calif. Also: **Dr. Karl Klager**, senior division manager, Solid Rocket Development; **Dr. A. O. Dekker**, senior division manager, Solid Rocket Research.

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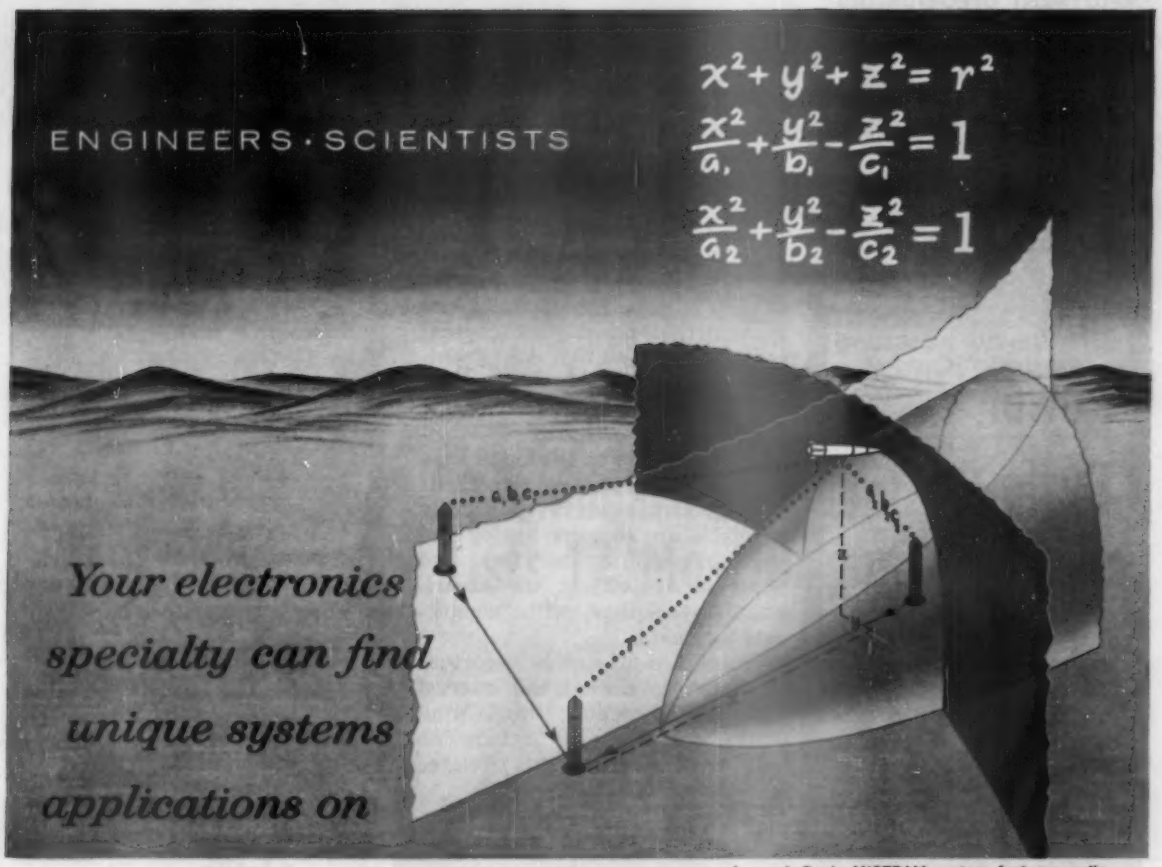

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▲ Basic MISTRAM system features radio receiving stations in "L"-shaped configuration. Signals from missile transponder are measured on CW carrier for computer calculation of phase differences. These yield missile position, velocity and trajectory data through spatial intersection of a sphere (range from central receiving station) and hyperboloids of revolution (range differences from remote receiving stations).

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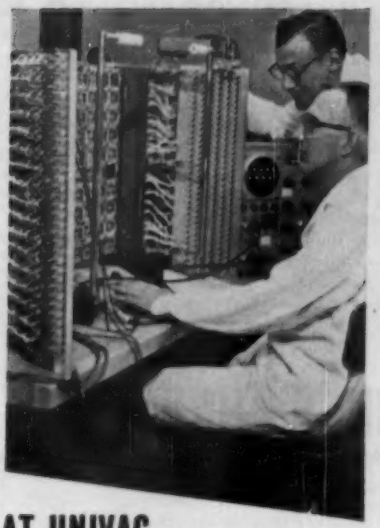

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FPD PROFESSIONAL EMPLOYMENT NEWS

PUBLISHED BY THE FLIGHT PROPULSION DIVISION OF GENERAL ELECTRIC IN CINCINNATI, OHIO / DECEMBER, 1960

FPD NEWS offers latest information on openings throughout the Division to interested engineers and scientists. Technical information and news relating to current projects will also appear from time to time in this column.

Technical Placement Manager Lists 17 'Most Urgent' Openings

The ever-broadening front of Flight Propulsion Division's power and propulsion programs at Cincinnati, Ohio encompasses turbojets for military and commercial aircraft propulsion, as well as industrial and marine applications, development of advanced liquid rocket engines, electrical space propulsion and nuclear based space power systems, electromechanical control devices and systems.

Engineering opportunities range over all areas of activity, but the 17 positions outlined below are of special interest at this time:

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Heat Transfer
Formulate and solve problems in heat convection, conduction, and radiation related to development of arc plasma jet rocket engine.

Fluid Dynamics
Conceive and direct projects in fluid dynamics, especially the flow of very high temperature gasses through supersonic nozzles.

Turbine Design
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Compressor Aerodynamics
Guide programs aimed at design, evaluation, and development of jet compressors. Coordinate activities of mechanical design, testing, and other related groups.

Control System Evaluation
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Control Systems Design
Establish jet engine control systems requirements and specifications, execute designs and analyses, initiate and direct test programs.

Propulsion System Evaluation
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Overhaul Liaison Specialist
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LETTERS

Powers Award

The opinions of Mr. Frank Harvey and Mr. Charles F. Roche (AW Oct. 17, p. 166), I believe, are both very rash and unjustified. No one but Francis G. Powers knows what actually took place on that flight and the events that followed. Was he actually shot down? If so, perhaps his detonation equipment was rendered useless. Perhaps his high-altitude pressure suit was malfunctioning and if he would have bailed out at 60-plus thousand feet he would not have remained conscious to take his own life. Perhaps his oxygen equipment was malfunctioning and he was suffering from hypoxia and didn't regain full consciousness until after his capture. These and many more are questions unanswered. U. S. News & World Report stated that Mr. Powers was very definitely brainwashed, and I don't think Mr. Harvey or anyone else is in a position to judge his actions.

The award is not completely out of order. Basically it is a good idea, however, there are many groups and individuals in the Air Force engaged in classified projects of this and similar nature that it would be impossible to determine the most worthy recipient.

I subscribe to AVIATION WEEK regularly and think it is the very best in aviation news.

ROBERT F. WEARLEY
Captain, USAF
APO 856, New York, N. Y.

Re: U-2 pilot award.

Oh, my, didn't we stir up a boiling pot! I was glad to see the response. I only ask: What took you so long?

The letters published in opposition to my award proposal have led me to the conclusion there is more to the over-flight story than has reached the press. Anyone care to comment?

I am convinced the best way to see what people are thinking is to take a minority stand. The big question in my mind is why the letter writers didn't state their opinions before I did. One gentleman mentioned "the type of thinking that is becoming more prevalent in the U. S." I am more concerned with the fact that too few people are openly saying and writing what they are thinking. That is the really important change in America.

There are too many loose ends in the Powers flight story to satisfy me. I am not sure exactly what Powers' orders were in the event of an emergency. The information published in the press to date has been fractional at best. At times I am compelled to feel the wrong man is receiving the ire of the nation.

Naive, perhaps I am. I feel it is more naive, however, not to question a governmental structure that allows a foreign nation to capitalize on our lack of coordination and thoroughness. Even if Powers had destroyed the U-2 and himself the Russian propaganda machine would have made a case of the incident. It has been said the Soviets were looking for an excuse to ruin the Summit. Why did we have to hand them the reason? It was another example of someone not thinking what the repercussions of failure might be. The Russians are making a concerted effort to sway the minds of men to their way of life. So far the U. S. has certainly helped the Russian cause.

I was out-voted on the Francis G. Powers Award. I accept defeat. I do not, gentlemen, consent to your way of thinking. There remain too many unanswered questions in the U-2 story.

I do agree with Don Llewellyn who proposes a "Poison Needle" award to the man in the Budget Bureau who decided it was cheaper to hire men who like to fly than to incorporate devices in the U-2 airframe that would have made the surveillance automatic. Amen.

JOHN ZAWISKI
Aeronautical Illustration Historian
Elgin, Ill.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Idlewild Defended

Your editorial, "Pity the Poor Passenger," in the Oct. 3 issue of AVIATION WEEK, must surely have been confusing to anyone at all familiar with the new passenger terminal facilities at New York International Airport.

In stating "London Airport and Idlewild are apparently still vying to see which can maintain a woodshed terminal for transatlantic passengers the longest . . ." you apparently are writing about a building (the temporary terminal) which now handles only a small fraction of overseas departures and no international arrivals, a building scheduled for demolition and replacement by a new multi-airline terminal as part of our decentralized terminal complex.

You completely neglected the fact that for the past three years the $30-million International Arrival and Airline Wing Buildings have served all passengers arriving from overseas who must clear Customs and all international passengers departing from New York on foreign flag airlines. You also have neglected to mention that since May, 1960, all departures of Pan American World Airways' flights have operated at the carrier's new $12-million unit terminal, and that Trans World Airlines currently is constructing a new terminal for its flights, to be completed in 1961. Thus, TWA is the only transatlantic carrier still operating in the Temporary Terminal Building and, at that, for departures only.

I fail to see how any passenger who has used one or another of the modern facilities described above, especially the "experienced commuter" to whom you refer, could possibly ignore their existence or deprecate their beauty and efficiency.

Regarding the passenger with baggage trying to make an interline connection, the airlines, who are responsible for the interline transfer of baggage, are well aware of the problems and have already taken steps to eliminate them. In reviewing the problems that exist at this airport or any other major airport for that matter, I think it reasonable that you should consider the level of traffic they serve and the problems that that traffic presents. Faced with the need to serve so many million passengers, the Terminal City approach used at New York International Airport and the design of the individual terminal buildings represent the optimum solution.

I can well appreciate your point of view as an air traveler exercising his prerogative to complain about facilities and services available to him. I am disappointed, however, that the knowledge and understanding that you should have had of the industry should not have caused you more objectively to present the facts.

JOHN R. WILEY, Director
Aviation Department
The Port of New York Authority
New York, N. Y.

(For description of Idlewild's new terminal facilities see AW Aug. 29, p. 36 and Sept. 5, p. 44, and for passenger reaction to these facilities see AW Nov. 7, p. 146. —ED.)

Bomb Burst Cover

To all the pilots who wrote us calling attention to what they believed to be an error in printing the Oct. 17 cover picture upside down: You are wrong. The cover picture of nine Hunter Mark 6s of RAF Treble One Squadron doing a bomb burst at Farnborough was printed right side up. Treble One Squadron does its nine-plane bomb burst downward as depicted; it has another seven-plane bomb burst maneuver upward in the conventional style.—Ed.

'Black Body'

On the Letters page of Oct. 10 (p. 134), the editor infers in his discussion of the coffee cup problem that the term "black body" has some visual significance, i.e., that black coffee may be a better black body than coffee with cream because it is darker. The fact is that whatever the truth may be in this case, it has nothing to do with appearances. The discussion is concerned with radiation in the infrared well beyond the visible region of the spectrum where water and snow, for example, in spite of their appearance, approach the ideal as black body radiators.

J. O. MORGAN
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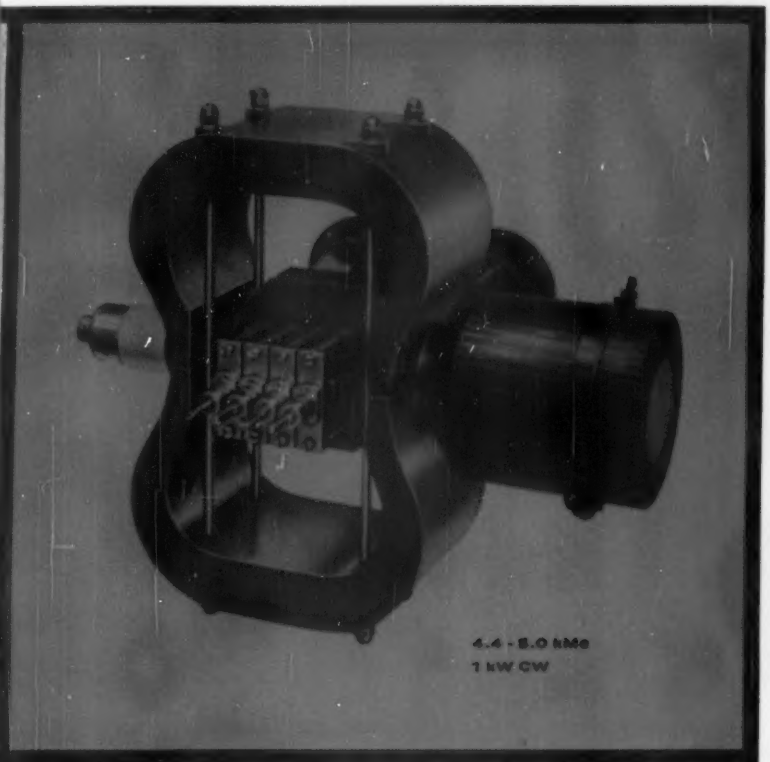

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